IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

OMNI MEDSCI, INC., *Plaintiff*, v. SAMSUNG ELECTRONICS, CO. LTD., SAMSUNG ELECTRONICS AMERICA, INC., FOSSIL GROUP, INC., FOSSIL STORES I, INC., FOSSIL PARTNERS, L.P., ONEPLUS TECHNOLOGY (SHENZHEN) CO., LTD., and ŌURA HEALTH OY, *Defendants*.	Civil No. 2:24-cv-01070-JRG-RSP JURY TRIAL DEMANDED

DEFENDANTS' INVALIDITY AND
SUBJECT MATTER ELIGIBILITY CONTENTIONS

Pursuant to Patent Rules 3-3 and 3-4 and the Docket Control Order entered by the Court (Dkt. 46), Defendants Samsung Electronics, Co. Ltd., Samsung Electronics America, Inc. (collectively "Samsung"), Fossil Group, Inc., Fossil Stores I, Inc., Fossil Partners, L.P. (collectively "Fossil"), and Ōura Health Oy ("Oura") (collectively "Defendants") hereby provide their Invalidity Contentions to Omni MedSci, Inc. ("Omni" or "Plaintiff").

Defendants' Invalidity Contentions include the accompanying claim charts concerning U.S. Patent Nos. 9,055,868 ("the '868 Patent"); 9,651,533 ("the '533 Patent"); 10,517,484 ("the '484 Patent"); 10,874,304 ("the '304 Patent"); 11,160,455 ("the '455 Patent"); 12,193,790 ("the '790 Patent") (collectively the "Asserted Patents").[1]

Defendants also submit their Subject Matter Eligibility Contentions concerning the

[1] The '484, '455, and '790 Patents are asserted against only Samsung and Fossil, not Oura.

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Asserted Patents in accordance with the Court's July 25, 2019, Standing Order Regarding Subject Matter Eligibility Contentions Applicable to All Patent Infringement Cases Assigned to Chief District Judge Rodney Gilstrap ("Standing Order") and the Docket Control Order.

I. Introduction

As disclosed in its respective P. R. 3-1 Infringement Contentions served on Defendants, Plaintiff asserts the following patents and claims:

Patent	**Asserted Claims**[2]	**Omni's Alleged Priority Date**	**Chart Prefix**
'868 Patent	Samsung: 7, 9 Fossil: 7-9 Oura: 7, 9	September 3, 2002	A
'533 Patent	Samsung: 11, 12 Fossil: 12 Oura: 11, 12	December 31, 2012	B
'484 Patent	Samsung: 8-10 Fossil: 8-9 Oura: n/a	December 31, 2012	C
'304 Patent	Samsung: 11, 14-16, 19-22 Fossil: 11, 14, 19-20 Oura: 11-14, 19-20	December 31, 2012	D
'455 Patent	Samsung: 1-3, 8-10, 15 Fossil: 1, 8 Oura: n/a	December 31, 2012	E
'790 Patent	Samsung: 7 Fossil: 7 Oura: n/a	December 31, 2012	F

The claims identified above are referenced as "the Asserted Claims" unless reference is made specifically with respect to particularly identified one or more of the Asserted Patents and/or one or more of the Asserted Claims. By identifying Omni's alleged priority date for the Asserted Claims of each patent above, Defendants do not concede that Omni's claims of priority are correct.

[2] *See* n.1.

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Further, the citation of prior art herein and the accompanying exhibits are not intended to reflect Defendants' claim construction contentions, which will be disclosed in due course in accordance with the Docket Control Order. Instead, Defendants' Invalidity Contentions and Subject Matter Eligibility Contentions as set forth herein and in the accompanying exhibits may reflect Plaintiff's apparent claim constructions based on its Infringement Contentions, with which Defendants disagree.

As further detailed in and supported by these Invalidity Contentions, Defendants contend that each of the Asserted Claims is invalid under at least 35 U.S.C. §§ 101, 102, 103, and/or 112.[3] Defendants reserve the right to prove the invalidity of the Asserted Claims on bases other than those required to be disclosed in these disclosures pursuant to P.R. 3-3.

II. Amendment / Supplementation

Defendants' Invalidity Contentions and Subject Matter Eligibility Contentions pertain to the Asserted Claims as identified in Plaintiff's Infringement Contentions. To the extent the Court later allows Plaintiff to amend its infringement contentions and/or assert one or more claims other than the Asserted Claims, Defendants reserve the right to modify, amend, or supplement these Invalidity Contentions and Subject Matter Eligibility Contentions accordingly—for example, to show the invalidity and/or ineligibility of any such newly Asserted Claims.

These Invalidity Contentions and Subject Matter Eligibility Contentions are based on Defendants' current understanding of the Asserted Claims and Plaintiff's apparent view of the scope of those claims as shown, for example, in Plaintiff's Infringement Contentions. A *Markman*

[3] References to Title 35 of the United States Code are to statutes prior to amendment under the America Invents Act ("AIA"), to the extent that the Asserted Patents have effective filing dates prior to applicable AIA effective dates, and to the current statutory provisions with respect to Asserted Patents having effective filing dates after the applicable AIA effective dates.

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Order in this case has not yet been issued, and in no way should these Invalidity Contentions and Subject Matter Eligibility Contentions be taken as any admission or acquiescence by Defendants as to the proper scope of the Asserted Claims and/or proper claim constructions of terms and phrases recited in those claims. By identifying prior art that anticipates and/or renders obvious the Asserted Claims, Defendants do not admit that the claim limitations are capable of construction, do not admit that any claim limitations are supported with an appropriate written description and enabling disclosure in the applicable patent specifications, and do not adopt Plaintiff's apparent claim constructions or admit the accuracy of any particular claim construction.[4] Defendants reserve all rights to later challenge or oppose any claim constructions advanced by Plaintiff and to present their own claim construction positions as permitted by the Court.

Defendants further reserve the right to revise these Invalidity Contentions and Subject Matter Eligibility Contentions in view of the Court's construction of terms and phrases recited in one or more of the Asserted Claims, additional information obtained during discovery, additional infringement theories put forth by Plaintiff during fact and/or expert discovery, any findings as to the priority date(s) of the Asserted Claims, and/or positions that Plaintiff, its fact witnesses, or its expert witness(es) may take concerning claim construction, infringement, and/or invalidity issues, as permitted by the Court. Defendants further reserve the right to supplement their accompanying P.R. 3-4(b) document productions should they later discover additional prior art documents, information, testimony, prior art systems and related documentation, and/or software or hardware

[4] Defendants do not concede that Plaintiff's apparent interpretation of the claims is correct, but rather assert the well-established principle that whatever infringes a claim if later in time anticipates if earlier in time. *Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc.*, 246 F.3d 1368, 1378 (Fed. Cir. 2001). Thus, where Plaintiff for purposes of its infringement case alleges that a feature of an accused product meets a particular limitation recited in one or more of the Asserted Claims, then that feature, should it be found in the prior art, would also cause that limitation to be met for invalidity purposes.

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code, including information provided by third parties after the date of service of these Invalidity Contention and Subject Matter Eligibility Contentions.

Additionally, Plaintiff has not identified in its contentions regarding the level of ordinary skill in the art for any of the Asserted Patents. Thus, Defendants have based their Invalidity and Subject Matter Eligibility Contentions on the level of skill in the art apparent from the face of the asserted patents. For the avoidance of doubt, Defendants contend that the asserted claims are invalid for the reasons set forth in their Invalidity and Subject Matter Eligibility contentions under any plausible definition of the level of ordinary skill for each of the Asserted Patents. Nevertheless, Defendants reserve the right to revise these Invalidity Contentions and Subject Matter Eligibility Contentions in response to any position taken by Plaintiff on the level of ordinary skill in the art applicable to a given Asserted Patent.

Defendants may further rely on inventor admissions concerning the scope or state of the prior art relevant to the Asserted Claims, the patent prosecution histories of the Asserted Patents, related patents and/or patent applications, any deposition or trial testimony of the named inventors on the Asserted Patents, and the papers filed and any evidence produced or submitted by Plaintiff in connection with these cases or other related litigation. Defendants reserve the right to contend that one or more of the Asserted Claims are invalid under 35 U.S.C. § 102(f) in the event Defendants obtain evidence that one or more of the named inventors did not invent the subject matter in the Asserted Claims.

Prior art not included in these Invalidity Contentions and Subject Matter Eligibility Contentions, whether known or not known to Defendants, may become relevant. Defendants are currently unaware of the extent, if any, to which Plaintiff will contend that limitations of the Asserted Claims are not disclosed in the prior art identified in these Invalidity Contentions and

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Subject Matter Eligibility Contentions. Accordingly, Defendants reserve the right to identify other references that would disclose the allegedly missing limitation(s) of the claimed method, device, or system.

The references identified in these Invalidity Contentions and Subject Matter Eligibility Contentions, which include the attached claim charts, may disclose the elements of the Asserted Claims explicitly and/or inherently, render those elements alone or in combination obvious to those of ordinary skill in the art even absent an explicit or inherent disclosure, and/or they may be relied upon to show the state of the art in the relevant time frame. References identified in these Invalidity Contentions and Subject Matter Eligibility Contentions, as well as the "References Cited" on the face of the Asserted Patents and the patents cited within the body of the Asserted Patents, may be used to illustrate, but not limit the scope of, the state of the art to which the Asserted Patents pertain (i.e., at a time prior to the date of alleged inventions of the Asserted Claims of the Asserted Patents). Moreover, Defendants reserve the ability to rely on later-identified sources of information, including but not limited to witness testimony and other discovery, to establish the state of the art in the relevant time frame pertaining to the Asserted Patents.

Because discovery has just recently begun, Defendants anticipate that additional prior art and invalidity bases may be found. Defendants' investigation and analysis of the prior art is continuing, and thus Defendants reserve the right to supplement, amend, and/or revise the information provided herein as Defendants conduct further investigation and/or analysis, including identifying, charting, and relying on additional references.

Additionally, in view of likely third-party discovery that will be taken, Defendants reserve the right to present additional items of prior art under 35 U.S.C. §§ 102(a), (b), (e), and/or (g) and/or § 103 located during discovery or further investigation, and to assert contentions of

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invalidity under 35 U.S.C. §§ 102(c), (d), or (f). For example, Defendants expect to issue subpoenas to third parties believed to have knowledge, documents, and/or other evidence concerning invalidity of one or more of the Asserted Claims.

In addition to the positions and prior art identified in these Invalidity Contentions and Subject Matter Eligibility Contentions (including the accompanying claim charts), Defendants also incorporate by reference all invalidity contentions and subject matter eligibility contentions, prior art,[5] and invalidity claim charts (including, without limitation, all anticipation positions, obviousness positions [including all prior art combinations and motivations to combine], indefiniteness positions, written description positions, and non-enablement positions) concerning one or more of the Asserted Patents, as disclosed at any time. This includes without limitation disclosures in previous or related litigation, in United States Patent & Trademark Office ("USPTO") proceedings, by the Plaintiff, by any other parties accused of patent infringement by the Plaintiff, or by the named inventors or any individuals associated with the prosecution and/or any form of post-grant review or reexamination of the Asserted Patents.

Specifically, for example, Defendants identify, as prior art upon which they may rely to show the invalidity of the Asserted Claims, the prior art references disclosed by parties in any other litigation (including inter partes review and/or reexamination proceedings) involving one or more of the Asserted Patents, any patent related to any of the Asserted Patents, and/or any other patent allegedly assigned to Plaintiff claiming priority to the Asserted Patents (collectively, "Other Omni Proceedings").

Plaintiff has a present and ongoing duty to produce to Defendants all relevant documents

[5] Prior art appearing in the file histories of the Asserted Patents is not required to be separately produced by Defendants under P. R. 3-4(b).

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from any Other Omni Proceedings, including but not limited to all prior art, invalidity contentions, and expert reports on invalidity (among other relevant items).

Defendants reserve the right to supplement or otherwise amend these Invalidity Contentions and Subject Matter Eligibility Contentions in response to any relevant discovery provided by third parties, Plaintiff, opening or rebuttal expert reports, fact or expert depositions, or in response to any claim construction ruling(s) issued by this Court (regardless of how and when such ruling is made). Defendants also reserve the right to supplement or otherwise amend these Invalidity Contentions and Subject Matter Eligibility Contentions in response to any rebuttal evidence disclosed by Plaintiff or as otherwise may be necessary or appropriate under the circumstances.

III. P. R. 3-3(a) – Identification of Prior Art

Pursuant to P.R. 3-3(a), and subject to Defendants' reservations of rights, Defendants identify each item of prior art that anticipates or renders obvious the Asserted Claims below.[6]

A. U.S. Patent No. 9,055,868

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '868 Patent are provided in attached Exhibits A1 through A10.

[6] Defendants' disclosure of prior art is premised on the alleged priority dates of the Asserted Patents as identified in Plaintiff's Infringement Contentions. Defendants contend Plaintiff is not entitled to the alleged priority dates and reserve the right to modify, amend, or supplement their invalidity contentions with additional prior art references if any Asserted Claim is shown to not be entitled to the respective alleged priority date or if Plaintiff alleges any other priority date for any of the Asserted Claims. Notwithstanding that reservation of rights, Defendants also reserve the right to argue that they have been unduly prejudiced should Plaintiff allege a different priority date for any of the Asserted Claims, and that accordingly Plaintiff should not be allowed to do so.

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Table 1-A: Prior Art Patents and Printed Publications for the ’868 Patent

Patent No. or Title (Primary Inventor/Author)	**Date of Issue/ Publication**	**Filing Date**
US 2003/0208113 (“Mault”) [Ex. A1]	Nov. 6, 2003	July 18, 2001
US 6,067,463 (“Jeng”) [Ex. A2]	May 23, 2000	Jan. 5, 1999
US 5,891,022 (“Pologe”) [Ex. A3]	April 6, 1999	Sept. 25, 1996
US 2002/0198473 (“Kumar”) [Ex. A4]	Dec. 26, 2002	March 28, 2002
US 2004/0002634 (“Nihtila”) [Ex. A5]	Jan. 1, 2004	June 28, 2002
JP 2000-74829 (“Shigeki”) [Ex. A6]	Sept. 2, 1999	March 14, 2000
US 6,168,563 (“Brown”) [Ex. A7]	Jan. 2, 2001	March 17, 1999
US 2002/0049389 (“Abreu”) [Ex. A8]	April 25, 2002	Feb. 23, 2001
US 6,602,191 (“Quy”) [Ex. A9]	Aug. 5, 2003	Dec. 15, 2000
US 5,830,137 (“Scharf”) [Ex. A10]	Nov. 3, 1998	Nov. 18, 1996

Table 2-A: Prior Art Systems and Inventions for the ’868 Patent

Name of System or Invention	**Date of Sale / Offer for Sale / Public Use / Known by Others**
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems, Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	At least as early as 1988
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.

Further, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-A.

Discovery is ongoing, and Defendants may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and Defendants reserve the right to supplement these contentions accordingly. Defendants continue to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserve the right to supplement these contentions and accompanying claim charts after further investigation.

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Defendants' reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '868 Patent. Defendants' investigation of such prior art systems is still ongoing, and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '868 Patent. As such, Defendants reserve all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '868 Patent. Defendants have obtained, and are in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this lawsuit, which Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in

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Defendants' possession, custody, or control available for inspection by Plaintiff.

Consequently, Defendants reserve the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, Defendants identify, responsive to Plaintiff's Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-A and 2-A as evidence of the state of the art as it relates to physiological monitoring devices / systems.

Each of these references show that the concept of "physiological monitoring" is not novel and was well-known for many years before the alleged priority date of the '868 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '868 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '868 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because Defendants have not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, Defendants reserve the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

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B. U.S. Patent No. 9,651,533

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the ’533 Patent are provided in attached Exhibits B1 through B8.

Table 1-B: Prior Art Patents and Printed Publications for the ’533 Patent

Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 2011/0028802 (“Addison”) [Ex. B1]	February 3, 2011	July 31, 2009
US 2015/0057511[7] (“Basu”) [Ex. B2]	February 26, 2015	March 27, 2013
US 2005/0049468 (“Carslon”) [Ex. B3]	March 3, 2005	September 3, 2003
US 2012/0197093 (“LeBoeuf”) [Ex. B4]	August 2, 2012	January 25, 2012
US 9,241,676 (“Lisogurski”) [Ex. B5]	January 26, 2016	May 31, 2012
US 9,596,990 (“Park”) [Ex. B6]	March 21, 2017	November 6, 2013
US 8,923,918 (“Kreger”) [Ex. B7]	December 30, 2014	December 18, 2010
US 7,507,207 (“Sakai”) [Ex. B8]	March 24, 2009	October 5, 2004

Table 2-B: Prior Art Systems and Inventions for the ’533 Patent

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems, Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	At least as early as 1988
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-

[7] Invalidity contentions relying on this reference herein will make reference to the Provisional Application No. 61/616524, which is incorporated by reference into Basu.

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical	At least as early as 2007

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.

Further, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-B.

Discovery is ongoing, and Defendants may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and

Defendants reserve the right to supplement these contentions accordingly. Defendants continue to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserve the right to supplement these contentions and accompanying claim charts after further investigation.

Defendants' reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '533 Patent. Defendants' investigation of such prior art systems is still ongoing, and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '533 Patent. As such, Defendants reserve all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '533 Patent. Defendants have obtained, and are in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this

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lawsuit, which Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in Defendants' possession, custody, or control available for inspection by Plaintiff.

Consequently, Defendants reserve the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, Defendants identify, responsive to Plaintiff's Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-B and 2-B as evidence of the state of the art as it relates to physiological monitoring devices / systems.

Each of these references show that the concept of "physiological monitoring" is not novel and was well-known for many years before the alleged priority date of the '533 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '533 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '533 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because Defendants have not yet completed discovery in this case, including taking

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depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, Defendants reserve the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

C. U.S. Patent No. 10,517,484

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '484 Patent are provided in attached Exhibits C1 through C14.

Table 1-C: Prior Art Patents and Printed Publications for the '484 Patent

Patent No. or Title (Primary Inventor/Author)	**Date of Issue/ Publication**	**Filing Date**
US 9,241,676 ("Lisogurski") [Ex. C1]	Jan. 26, 2016	May 31, 2012
US 2015/0057511 ("Basu") [Ex. C2]	Feb. 26, 2015	Mar. 27, 2013
US 6,616,613 ("Goodman") [Ex. C3]	Sep. 9, 2003	Apr. 29, 2000
WO 2012/099536 ("Kassim") [Ex. C4]	Jul. 26, 2012	Jan. 20, 2011
US 9,095,291 ("Soller") [Ex. C5]	Aug. 4, 2015	Aug. 7, 2009
US 11,638,532 ("Poeze") [Ex. C6]	May 2, 2023	Jul. 1, 2010
US 2012/0150047 ("Terumoto") [Ex. C7]	June 14, 2012	Nov. 14, 2011
US 8,172,761 ("Rulkov") [Ex. C8]	May 8, 2012	Oct. 4, 2011
US 2011/0066050 ("Moon") [Ex. C9]	Mar. 17, 2011	Sep. 15, 2009
US 2005/0049468 ("Carlson") [Ex. C10]	Mar. 3, 2005	Sep. 3, 2003
US 8,108,036 ("Tran") [Ex. C11]	Jan. 31, 2012	Jun. 18, 2009
Plug-and-Play, Single-Chip Photoplethysmography ("Chandrasekar") [Ex. C12]	Sep. 2012	N/A
US 8,923,918 ("Kreger") [Ex. C13]	Dec. 30, 2014	Dec. 18, 2010
US 7,507,207 ("Sakai") [Ex. C14]	Mar. 24, 2009	Oct. 5, 2004

Table 2-C: Prior Art Systems and Inventions for the '484 Patent

Name of System or Invention	**Date of Sale / Offer for Sale / Public Use / Known by Others**
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems,	At least as early as 1988

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35

U.S.C. §§ 102 and/or 103.

Further, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-C.

Discovery is ongoing, and Defendants may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and Defendants reserve the right to supplement these contentions accordingly. Defendants continue to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserve the right to supplement these contentions and accompanying claim charts after further investigation.

Defendants' reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '484 Patent. Defendants' investigation of such prior art systems is still ongoing, and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '484 Patent. As such, Defendants reserve all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '484 Patent. Defendants have obtained, and are in the process of obtaining,

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additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this lawsuit, which Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in Defendants' possession, custody, or control available for inspection by Plaintiff.

Consequently, Defendants reserve the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, Defendants identify, responsive to Plaintiff's Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-C and 2-C as evidence of the state of the art as it relates to physiological monitoring devices / systems.

Each of these references show that the concept of "physiological monitoring" is not novel and was well-known for many years before the alleged priority date of the '484 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '484 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '484 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such

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reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because Defendants have not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, Defendants reserve the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

D. U.S. Patent No. 10,874,304

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '304 Patent are provided in attached Exhibits D1 through D19.

Table 1-D: Prior Art Patents and Printed Publications for the '304 Patent

Patent No. or Title (Primary Inventor/Author)	**Date of Issue/ Publication**	**Filing Date**
US 2015/0057511A1 ("Basu") [Ex. D1]	2/26/2015	3/27/2013
US 2005/0049468A1 ("Carlson") [Ex. D2]	3/3/2005	9/3/2003
US 6,616,613 ("Goodman") [Ex. D3]	9/9/2003	4/27/2000
US 6,519,037B2 ("Jung") [Ex. D4]	2/11/2003	6/1/2001
WO 2012/99536 ("Kassim") [Ex. D5]	7/26/2012	1/20/2011
US 2011/0237911A1 ("Lamego") [Ex. D6]	9/29/2011	3/28/2011
US 2010/0217102A1 ("LeBoeuf") [Ex. D7]	8/26/2010	1/21/2010
US 9,241,676 ("Lisogurski") [Ex. D8]	1/26/2016	5/31/2012
US 5,746,206 ("Mannheimer") [Ex. D9]	5/5/1998	6/10/1996
US 2003/0208113A1 ("Mault") [Ex. D10]	11/6/2003	7/18/2001
US 2011/0082711A1 ("Poeze") [Ex. D11]	4/7/2011	10/5/2010
US 5,891,022 ("Pologe") [Ex. D12]	4/6/1999	9/25/1996
US 8,108,036 ("Tran") [Ex. D13]	1/31/2012	6/18/2009
US 2012/0197093A1 ("Valencell") [Ex. D14]	8/2/2012	1/25/2012

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Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
D. Chandrasekar, et al., "Plug-and-Play, Single-Chip Photoplethysmography" ("Chandrasekar2012") [Ex. D15]	8/28/2012 - 9/1/2012	received 3/29/12
US 7,507,207 ("Sakai") [Ex. D16]	3/24/2009	10/5/2004
US 8,923,918 ("Kreger") [Ex. D17]	12/30/2014	12/18/2010
US 2006/0184040 ("Keller") [Ex. D18]	8/17/2006	12/7/2005
US 7,139,076 ("Marbach") [Ex. D19]	11/21/2006	8/8/2003

Table 2-D: Prior Art Systems and Inventions for the '304 Patent

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems, Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	At least as early as 1988
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.

Further, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-D.

Discovery is ongoing, and Defendants may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and Defendants reserve the right to supplement these contentions accordingly. Defendants continue to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserve the right to supplement these contentions and accompanying claim charts after further investigation.

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Defendants' reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '304 Patent. Defendants' investigation of such prior art systems is still ongoing, and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '304 Patent. As such, Defendants reserve all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '304 Patent. Defendants have obtained, and are in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this lawsuit, which Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in

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Defendants' possession, custody, or control available for inspection by Plaintiff.

Consequently, Defendants reserve the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, Defendants identify, responsive to Plaintiff's Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-D and 2-D as evidence of the state of the art as it relates to physiological monitoring device/system.

Each of these references show that the concept of "physiological monitoring" is not novel and was well-known for many years before the alleged priority date of the '304 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '304 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '304 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because Defendants have not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, Defendants reserve the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

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E. U.S. Patent No. 11,160,455

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the ’455 Patent are provided in attached Exhibits E1 through E18.

Table 1-E: Prior Art Patents and Printed Publications for the ’455 Patent

Patent No. or Title (Primary Inventor/Author)	**Date of Issue/ Publication**	**Filing Date**
US 2015/0057511A1 (“Basu”) [Ex. E1]	2/26/2015	3/27/2013
US 2005/0049468A1 (“Carlson”) [Ex. E2]	3/3/2005	9/3/2003
US 6,616,613 (“Goodman”) [Ex. E3]	9/9/2003	4/27/2000
US 6,519,037B2 ("Jung") [Ex. E4]	2/11/2003	6/1/2001
WO 2012/99536 (“Kassim”) [Ex. E5]	7/26/2012	1/20/2011
US 2011/0237911A1 (“Lamego”) [Ex. E6]	9/29/2011	3/28/2011
US 2010/0217102A1 (“LeBoeuf”) [Ex. E7]	8/26/2010	1/21/2010
US 9,241,676 (“Lisogurski”) [Ex. E8]	1/26/2016	5/31/2012
US 5,746,206 (“Mannheimer”) [Ex. E9]	5/5/1998	6/10/1996
US 2003/0208113A1 (“Mault”) [Ex. E10]	11/6/2003	7/18/2001
US 2011/0082711A1 (“Poeze”) [Ex. E11]	4/7/2011	10/5/2010
US 5,891,022 (“Pologe”) [Ex. E12]	4/6/1999	9/25/1996
US 8,108,036 (“Tran”) [Ex. E13]	1/31/2012	6/18/2009
US 2012/0197093A1 (“Valencell”) [Ex. E14]	8/2/2012	1/25/2012
D. Chandrasekar, et al., “Plug-and-Play, Single-Chip Photoplethysmography” (“Chandrasekar2012”) [Ex. E15]	8/28/2012 - 9/1/2012	received 3/29/12
US 7,507,207 ("Sakai") [Ex. E16]	3/24/2009	10/5/2004
US 8,923,918 ("Kreger") [Ex. E17]	12/30/2014	12/18/2010
US 8,725,226 (“Isaacson”) [Ex. E18]	5/13/2014	11/13/2009

Table 2-E: Prior Art Systems and Inventions for the ’455 Patent

Name of System or Invention	**Date of Sale / Offer for Sale / Public Use / Known by Others**
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems,	At least as early as 1988

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35

U.S.C. §§ 102 and/or 103.

Further, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-E.

Discovery is ongoing, and Defendants may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and Defendants reserve the right to supplement these contentions accordingly. Defendants continue to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserve the right to supplement these contentions and accompanying claim charts after further investigation.

Defendants' reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '455 Patent. Defendants' investigation of such prior art systems is still ongoing and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether or not any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '455 Patent. As such, Defendants reserve all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '455 Patent. Defendants have obtained, and are in the process of obtaining,

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additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the particular individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third party discovery during this lawsuit, which Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in Defendants' possession, custody, or control available for inspection by Plaintiff.

Consequently, Defendants reserve the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, Defendants identify, responsive to Plaintiff's Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-E and 2-E as evidence of the state of the art as it relates to physiological monitoring devices / systems.

Each of these references show that the concept of "physiological monitoring" is not novel and was well-known for many years before the alleged priority date of the '455 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '455 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '455 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such

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reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because Defendants have not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, Defendants reserve the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

F. U.S. Patent No. 12,193,790

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '790 Patent are provided in attached Exhibits F1 through F14.

Table 1-F: Prior Art Patents and Printed Publications for the '790 Patent

Patent No. or Title (Primary Inventor/Author)	**Date of Issue/ Publication**	**Filing Date**
US 9,241,676 ("Lisogurski") [Ex. F1]	Jan. 26, 2016	May 31, 2012
US 2015/0057511 ("Basu") [Ex. F2]	Feb. 26, 2015	Mar. 27, 2013
US 6,616,613 ("Goodman") [Ex. F3]	Sep. 9, 2003	Apr. 29, 2000
WO 2012/099536 ("Kassim") [Ex. F4]	Jul. 26, 2012	Jan. 20, 2011
US 9,095,291 ("Soller") [Ex. F5]	Aug. 4, 2015	Aug. 7, 2009
US 11,638,532 ("Poeze") [Ex. F6]	May 2, 2023	Jul. 1, 2010
US 2012/0150047 ("Terumoto") [Ex. F7]	June 14, 2012	Nov. 14, 2011
US 8,172,761 ("Rulkov") [Ex. F8]	May 8, 2012	Oct. 4, 2011
US 2011/0066050 ("Moon") [Ex. F9]	Mar. 17, 2011	Sep. 15, 2009
US 2005/0049468 ("Carlson") [Ex. F10]	Mar. 3, 2005	Sep. 3, 2003
US 2008/0242958 ("Al-Ali") [Ex. F11]	Oct. 2, 2008	Mar. 26, 2008
Plug-and-Play, Single-Chip Photoplethysmography ("Chandrasekar") [Ex. F12]	September 2012	N/A
US 8,923,918 ("Kreger") [Ex. F13]	Dec. 30, 2014	Dec. 18, 2010
US 7,507,207 ("Sakai") [Ex. F14]	Mar. 24, 2009	Oct. 5, 2004

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Table 2-F: Prior Art Systems and Inventions for the ’790 Patent

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems, Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	At least as early as 1988
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are in the process of

attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.

Further, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-F.

Discovery is ongoing, and Defendants may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and Defendants reserve the right to supplement these contentions accordingly. Defendants continue to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserve the right to supplement these contentions and accompanying claim charts after further investigation.

Defendants' reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '790 Patent. Defendants' investigation of such prior art systems is still ongoing, and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether any of the third-party

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prior art systems anticipate or render obvious the Asserted Claims of the '790 Patent. As such, Defendants reserve all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '790 Patent. Defendants have obtained, and are in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this lawsuit, which Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in Defendants' possession, custody, or control available for inspection by Plaintiff.

Consequently, Defendants reserve the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, Defendants identify, responsive to Plaintiff's Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-F and 2-F as evidence of the state of the art as it relates to physiological monitoring devices / systems.

Each of these references show that the concept of "physiological monitoring" is not novel and was well-known for many years before the alleged priority date of the '790 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the

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Asserted Claims of the ’790 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the ’790 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because Defendants have not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, Defendants reserve the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

G. State of the Art

Defendants identify, responsive to Plaintiff’s infringement contentions, the references listed in Tables 1-A through 1-F, Tables 2-A through 2-F, and the following patents, publications, and systems as evidence of the state of the art as it relates to each of the Asserted Patents:

- U.S. Patent No. 3,514,538
- U.S. Patent No. 3,789,601
- U.S. Patent No. 4,015,595
- U.S. Patent No. 4,589,078
- U.S. Patent No. 4,591,659
- U.S. Patent No. 4,941,236
- U.S. Patent No. 5,028,787
- U.S. Patent No. 5,222,496,
- U.S. Patent No. 5,254,388
- U.S. Patent No. 5,259,381
- U.S. Patent No. 5,267,152
- U.S. Patent No. 5,334,916

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- U.S. Patent No. 5,348,002
- U.S. Patent No. 5,370,114
- U.S. Patent No. 5,527,261
- U.S. Patent No. 5,555,882
- U.S. Patent No. 5,590,652
- U.S. Patent No. 5,632,272
- U.S. Patent No. 5,638,818
- U.S. Patent No. 5,687,721
- U.S. Patent No. 5,746,206
- U.S. Patent No. 5,795,300
- U.S. Patent No. 5,807,261
- U.S. Patent No. 5,830,137
- U.S. Patent No. 5,879,294
- U.S. Patent No. 5,924,069
- U.S. Patent No. 6,018,673
- U.S. Patent No. 6,064,898
- U.S. Patent No. 6,067,463
- U.S. Patent No. 6,081,782
- U.S. Patent No. 6,108,634
- U.S. Patent No. 6,120,460
- U.S. Patent No. 6,126,595
- U.S. Patent No. 6,152,876
- U.S. Patent No. 6,158,245
- U.S. Patent No. 6,168,563
- U.S. Patent No. 6,171,237
- U.S. Patent No. 6,172,743
- U.S. Patent No. 6,174,291
- U.S. Patent No. 6,178,343
- U.S. Patent No. 6,278,975
- U.S. Patent No. 6,285,454
- U.S. Patent No. 6,293,915
- U.S. Patent No. 6,336,900
- U.S. Patent No. 6,343,223
- U.S. Patent No. 6,393,311
- U.S. Patent No. 6,483,976
- U.S. Patent No. 6,505,133
- U.S. Patent No. 6,553,242
- U.S. Patent No. 6,584,336
- U.S. Patent No. 6,591,239
- U.S. Patent No. 6,591,239
- U.S. Patent No. 6,602,191
- U.S. Patent No. 6,605,038
- U.S. Patent No. 6,608,562
- U.S. Patent No. 6,648,820

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- U.S. Patent No. 6,705,990
- U.S. Patent No. 6,705,991
- U.S. Patent No. 6,801,799
- U.S. Patent No. 6,816,266
- U.S. Patent No. 6,886,964
- U.S. Patent No. 6,912,413
- U.S. Patent No. 6,937,885
- U.S. Patent No. 6,961,599
- U.S. Patent No. 6,990,365
- U.S. Patent No. 7,031,728
- U.S. Patent No. 7,236,811
- U.S. Patent No. 7,346,174
- U.S. Patent No. 7,403,804
- U.S. Patent No. 7,507,207
- U.S. Patent No. 7,624,028
- U.S. Patent No. 7,658,613
- U.S. Patent No. 7,899,506
- U.S. Patent No. 8,095,195
- U.S. Patent No. 8,108,036
- U.S. Patent No. 8,125,331
- U.S. Patent No. 8,172,761
- U.S. Patent No. 8,326,390
- U.S. Patent No. 8,537,343
- U.S. Patent No. 8,670,819
- U.S. Patent No. 8,725,226
- U.S. Patent No. 8,764,651
- U.S. Patent No. 8,923,918
- U.S. Patent No. 9,055,868
- U.S. Patent No. 9,241,676
- U.S. Patent No. 9,392,946
- U.S. Patent No. 9,596,990
- U.S. Patent No. 9,651,633
- U.S. Patent No. 9,820,658
- U.S. Patent No. 10,517,484
- U.S. Patent No. 10,729,335
- U.S. Patent No. 10,729,335
- U.S. Patent No. 10,874,304
- U.S. Patent No. 11,160,455
- U.S. Patent No. 11,242,072
- U.S. Patent No. 11,330,993
- U.S. Patent No. 11,342,072
- U.S. Patent No. 12,193,790
- “Plug-and-Play, Single-Chip Photoplethysmography”, by D. Chandrasekar, B. Arnetz, P. Levy, A. Basu

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- "Supercontinuum generation from ~1.9 to 4:5 μm in ZBLAN fiber with high average power generation beyond 3:8 μm using a thulium-doped fiber amplifier" by O. Kulkarni, V. Alexander, M. Kumar, M.Freeman, M. N. Islam, F. Terry, Jr., M. Neelakandan, and A. Chan
- "Supercontinuum Generation in Silica Fibers by Amplified Nanosecond Laser Diode Pulses" by C. Xia, M. Kumar, M. Cheng, O. Kulkarni, M. Islam, A. Galvanauskas, F. Terry, Jr., M. Freeman, D. Nolan, and W. Wood
- "Towards a Wearable Non-invasive Blood Glucose Monitoring Device" by J. Anders, J. Solanki, O. Choudhary, S. Chouksey, N. Malvia, P. Chaturvedi, and P. Sen
- "Open Data Kit Sensors: Mobile Data Collection with Wired and Wireless Sensors" by R. Chaudhri, W. Brunette, M. Goel, R. Sodt, J. VanORden, M. Falcone, G. Borriello
- "Android Based Body Area Network for the Evaluation of Medical Parameters" by M. Wagner, B. Kuch, C. Cabrera, P. Enoksson, A. Sieber
- "Noninvasice Cardiac Output Estimation Using a Novel Photoplethsymogram Index" by L. Wang, E. Pickwell-MacPherson, Y.P. Liang, Y.T. Zhang
- "Towards a Wearable Non-invasive Blood Glucose Monitoring Device" by J. Andrews, J. Solanki, O. Choudhary, S. Chouksey, N. Malvia, P. Chaturvedi, P. Sen

IV. P. R. 3-3(b) – Invalidity Grounds

Pursuant to P.R. 3-3(b), Defendants contend that certain prior art references below anticipate one or more Asserted Claims and that to the extent the identified prior art references do not anticipate the Asserted Claims, those claims are invalid as obvious under 35 U.S.C. §103. Each anticipatory prior art reference, either alone or in combination with other prior art, also renders the Asserted Claims invalid as obvious. In particular, each anticipatory prior art reference may be combined with (1) information generally known to persons skilled in the art at the time of the alleged invention, and/or (2) any of the other identified prior art references. To the extent that Plaintiff contends that any of the anticipatory prior art fails to disclose one or more limitations of the Asserted Claims, Defendants contend that any difference between the reference and the corresponding patent claims would have been obvious to one of ordinary skill in the art. Thus, all anticipation charts should be interpreted as both reflecting anticipation by the reference as well as invalidity due to single reference obviousness, to the extent that Plaintiff contends that any limitation is missing.

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A. Anticipation

As stated above, Defendants incorporate by reference all other invalidity contentions related to the Asserted Patents served on or otherwise provided to Plaintiff, whether past or future. In accordance with P.R. 3-3(a), prior art references anticipating the Asserted Claims are provided below. The prior art listed below anticipates the Asserted Claims under the proper construction of the claims and/or under Plaintiff's apparent interpretation of the claims reflected by Plaintiff's Complaint and Infringement Contentions.

1. U.S. Patent No. 9,055,868

The Asserted Claims of the '868 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), Defendants identify the prior art references that anticipate or render obvious the '868 Patent Asserted Claims in the claim charts of Exhibits A1 through A10 (collectively "Appendix A") which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix A show how these prior art references teach or suggest each and every element of the '868 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, Defendants indicate whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the '868 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix A, Defendants further contend that the '868 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, Defendants continue to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '868 Patent Asserted Claims are invalid in view of the

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explicit disclosures of the prior art references cited in the claim charts of Appendix A, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

Defendants' reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix A should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix A that relates to the cited component, circuit, software program, device, or product. In addition, Defendants may rely on other documents or things that have not yet been located to support its contentions regarding such prior art component(s), circuit(s), software program(s), device(s) or product(s) that are referenced in the charts.

Defendants incorporate by reference, as if set forth fully herein, all prior art cited during the prosecution of the '868 Patent, all prior art cited during reexamination proceedings of the '868 Patent, all prior art as described in any future *inter partes* review proceedings of the '868 Patent, and all prior art disclosed during previous litigation proceedings.

Defendants further identify and hereby incorporate by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the '868 Patent, its foreign counterparts, or any parent or child patent of the '868 Patent. Defendants reserve the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence

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the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where Defendants identify a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), Defendants' citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. Defendants therefore reserve the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

Defendants also reserve the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of

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the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix A.

2. U.S. Patent No. 9,651,533

The Asserted Claims of the '533 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), Defendants identify the prior art references that anticipate or render obvious the '533 Patent Asserted Claims in the claim charts of Exhibits B1 through B8 (collectively "Appendix B") which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix B show how these prior art references teach or suggest each and every element of the '533 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, Defendants indicate whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the '533 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix B, Defendants further contend that the '533 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, Defendants continue to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '533 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix B, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan

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reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

Defendants' reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix B should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix B that relates to the cited component, circuit, software program, device, or product. In addition, Defendants may rely on other documents or things that have not yet been located to support its contentions regarding such prior art component(s), circuit(s), software program(s), device(s) or product(s) that are referenced in the charts.

Defendants incorporate by reference, as if set forth fully herein, all prior art cited during the prosecution of the '533 Patent, all prior art cited during reexamination proceedings of the '533 Patent, all prior art as described in any future *inter partes* review proceedings of the '533 Patent, and all prior art disclosed during previous litigation proceedings.

Defendants further identify and hereby incorporate by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the '533 Patent, its foreign counterparts, or any parent or child patent of the '533 Patent. Defendants reserve the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where Defendants identify a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text

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relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), Defendants' citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. Defendants therefore reserve the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

Defendants also reserve the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix B.

3. U.S. Patent No. 10,517,484

The Asserted Claims of the '484 Patent are anticipated and/or rendered obvious by prior

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art. Pursuant to P.R. 3-3(a), Defendants identify the prior art references that anticipate or render obvious the '484 Patent Asserted Claims in the claim charts of Exhibits C1 through C14 (collectively "Appendix C") which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix C show how these prior art references teach or suggest each and every element of the '484 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, Defendants indicate whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the '484 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix C, Defendants further contend that the '484 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, Defendants continue to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '484 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix C, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

Defendants' reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix C should be interpreted alternatively as both as a

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reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix C that relates to the cited component, circuit, software program, device, or product. In addition, Defendants may rely on other documents or things that have not yet been located to support its contentions regarding such prior art component(s), circuit(s), software program(s), device(s) or product(s) that are referenced in the charts.

Defendants incorporate by reference, as if set forth fully herein, all prior art cited during the prosecution of the '484 Patent, all prior art cited during reexamination proceedings of the '484 Patent, all prior art as described in any future *inter partes* review proceedings of the '484 Patent, and all prior art disclosed during previous litigation proceedings.

Defendants further identify and hereby incorporate by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the '484 Patent, its foreign counterparts, or any parent or child patent of the '484 Patent. Defendants reserve the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where Defendants identify a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), Defendants' citations to specific statements, figures, or disclosures in a prior art reference are

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sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. Defendants therefore reserve the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

Defendants also reserve the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix C.

4. U.S. Patent No. 10,874,304

The Asserted Claims of the ’304 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), Defendants identify the prior art references that anticipate or render obvious the ’304 Patent Asserted Claims in the claim charts of Exhibits D1 through D19 (collectively “Appendix D”) which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix D show how these prior art references teach or suggest each and

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every element of the ’304 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, Defendants indicate whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the ’304 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix D, Defendants further contend that the ’304 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, Defendants continue to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the ’304 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix D, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

Defendants’ reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix D should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix D that relates to the cited component, circuit, software program, device, or product. In addition, Defendants may rely on other documents or things that have not yet been located to support its contentions regarding such prior art component(s), circuit(s), software

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program(s), device(s), or product(s) that are referenced in the charts.

Defendants incorporate by reference, as if set forth fully herein, all prior art cited during the prosecution of the '304 Patent, all prior art cited during reexamination proceedings of the '304 Patent, all prior art as described in any *inter partes* review proceedings of the '304 Patent, and all prior art disclosed during previous litigation proceedings.

Defendants further identify and hereby incorporate by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the '304 Patent, its foreign counterparts, or any parent or child patent of the '304 Patent. Defendants reserve the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where Defendants identify a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), Defendants' citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior

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art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. Defendants therefore reserve the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

Defendants also reserve the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix D.

5. U.S. Patent No. 11,160,455

The Asserted Claims of the ’455 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), Defendants identify the prior art references that anticipate or render obvious the ’455 Patent Asserted Claims in the claim charts of Exhibits E1 through E18 (collectively “Appendix E”) which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix E show how these prior art references teach or suggest each and every element of the ’455 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, Defendants indicate whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the ’455 Patent Asserted Claims are invalid in view of the

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prior art references cited in the claim charts of Appendix E, Defendants further contend that the '455 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, Defendants continue to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '455 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix E, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

Defendants' reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix E should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix E that relates to the cited component, circuit, software program, device, or product. In addition, Defendants may rely on other documents or things that have not yet been located to support its contentions regarding such prior art component(s), circuit(s), software program(s), device(s) or product(s) that are referenced in the charts.

Defendants incorporate by reference, as if set forth fully herein, all prior art cited during the prosecution of the '455 Patent, all prior art cited during reexamination proceedings of the '455 Patent, all prior art as described in any future *inter partes* review proceedings of the '455 Patent,

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and all prior art disclosed during previous litigation proceedings.

Defendants further identify and hereby incorporate by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the '455 Patent, its foreign counterparts, or any parent or child patent of the '455 Patent. Defendants reserve the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where Defendants identify a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), Defendants' citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. Defendants therefore reserve the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the

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identified portions.

Defendants also reserve the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix E.

6. U.S. Patent No. 12,193,790

The Asserted Claims of the ’790 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), Defendants identify the prior art references that anticipate or render obvious the ’790 Patent Asserted Claims in the claim charts of Exhibits F1 through F14 (collectively “Appendix F”) which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix F show how these prior art references teach or suggest each and every element of the ’790 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, Defendants indicate whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the ’790 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix F, Defendants further contend that the ’790 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, Defendants

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continue to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '790 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix F, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

Defendants' reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix F should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix F that relates to the cited component, circuit, software program, device, or product. In addition, Defendants may rely on other documents or things that have not yet been located to support its contentions regarding such prior art component(s), circuit(s), software program(s), device(s) or product(s) that are referenced in the charts.

Defendants incorporate by reference, as if set forth fully herein, all prior art cited during the prosecution of the '790 Patent, all prior art cited during reexamination proceedings of the '790 Patent, all prior art as described in any future *inter partes* review proceedings of the '790 Patent, and all prior art disclosed during previous litigation proceedings.

Defendants further identify and hereby incorporate by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the '790 Patent, its foreign

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counterparts, or any parent or child patent of the ’790 Patent. Defendants reserve the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where Defendants identify a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), Defendants’ citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. Defendants therefore reserve the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

Defendants also reserve the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining

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certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix F.

B. Obviousness

As stated above, Defendants incorporate by reference all other invalidity contentions related to the Asserted Patents served on or otherwise provided to Plaintiff, whether past or in the future. In addition to certain claims being anticipated at least under Plaintiff's apparent claim constructions as indicated above, the Asserted Claims are also invalid as obvious over the same teachings identified for anticipation. Further, the Asserted Claims are obvious over various combinations of the references shown in the claim charts accompanying or incorporated by reference into this disclosure. No Asserted Claim goes beyond combining known elements to achieve predictable results or does more than choose between clear alternatives known to those of skill in the art. Thus, to the extent that an Asserted Claim is not anticipated, it is nevertheless invalid as obvious. Specifically, Defendants assert that any charted or incorporated reference in combination with one or more other charted or incorporated references renders the Asserted Claims obvious.

In *KSR International Co. v. Teleflex, Inc.*, the United States Supreme Court held that, among other things, "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." 550 U.S. 398, 416 (2007); *see also id.* at 417 ("[A] court must ask whether the improvement is more than the predictable use of

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prior art elements according to their established functions."). A patent is obvious where "the content of the prior art, the scope of the patent claim, and the level of ordinary skill are not in material dispute, and the obviousness of the claim is apparent in light of these factors." *Id.* at 427. The Supreme Court found that "if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." *Id.* at 417.

Moreover, the Supreme Court recognizes that market pressures will motivate a person of ordinary skill to survey known art for solutions to problems. *Id.* at 421 ("When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp."). When a person of ordinary skill uses an identified, predictable solution to solve a problem, "it is likely the product not of innovation but of ordinary skill and common sense." *Id.* In addition, when a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. *Id.* at 417. If a person of ordinary skill can implement a predictable variation, U.S.C. § 103 bars its patentability. *Id.*

"'[A]ny need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.'" *Intel Corp. v. PACT XPP Schweiz AG,* 61 F.4th 1373, 1379 (Fed. Cir. 2023) (quoting *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 420 (2007)). "Additionally, 'universal' motivations known in a particular field to improve technology provide 'a motivation to combine prior art references ***even absent any hint of suggestion*** in the references themselves.'" *Id.* (quoting *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 797-99 (Fed. Cir. 2021)) (original emphasis). Thus, motivations to

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combine, as well as the general state of the art, may be found in a variety of places including, but not limited to, in the references defined above, and the specification of the Asserted Patents. For example, each piece of prior art relates to systems and methods for physiological monitoring devices / systems. A person of ordinary skill in the art at the time of the alleged invention would have been motivated to combine any one piece of identified prior art with any other identified piece of prior art. For at least this reason, it would have been obvious to a person of skill in the art at the time of the alleged invention of the Asserted Claims to combine the various references cited herein so as to practice the Asserted Claims and there is a motivation in the art to make such a combination. Further reasons to combine the references identified in these charts include the nature of the problem being solved, the express, implied, and/or inherent teachings of the prior art, the knowledge of persons of ordinary skill in the art, the fact that the prior art is generally directed towards methods and systems for physiological monitoring, that such combinations would have yielded predictable results, and that such combinations would have represented known alternatives to a person of ordinary skill in the art.

The law does not require evidence of a specific motivation to combine prior art where the combiation would yield expected results and at most simply represents a known alternative or design choice to one of skill in the art. *See Apple Inc. v. Samsung Elecs. Co*., 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co*., 869 F.3d 1336, 1344 (Fed. Cir. 2017); *KSR Int'l Co. v. Teleflex, Inc*., 127 S. Ct. 1727, 1739-40 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, and instead applying an "expansive and flexible" approach). Indeed, the Supreme Court held that a POSITA is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of

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a puzzle." *KSR*, 550 U.S. at 420-21.

Nevertheless, in addition to the information contained immediately above and elsewhere in these contentions, Defendants identify additional motivations and reasons to combine. For example, in addition to the specific motivations identified herein, motivation to modify a particular reference or to combine any two or more of the identified references comes from (a) the nature of the problem being solved, (b) the teachings of the prior art, (c) the knowledge of persons of ordinary skill in the art, (d) the fact that all of the references teach systems, apparatuses, and methods related to the subject matter and address the same technical issues described in the Asserted Patents, and (e) one would be motivated by considerations of efficiency, effectiveness, convenience, cost-savings, and accessibility, to combine the various teachings of the references. Additionally, one would be motivated to address the alleged problems or achieve the purported objectives identified in the Background sections of the Asserted Patents, of the references cited on the face of the Asserted Patents, and of the other references cited herein.

In sum, motivations to modify or combine the identified references including the references listed above can be found via, for example, discussions in the cited references, the state of the art discussed in the references, and the knowledge of one of ordinary skill in the art. One of ordinary skill in the art would have been motivated to combine these references, because these references relate to common objectives and subject matter. The references share commonalities in terms of their general subject matter as well as the types of equipment, products, systems, and/or methods used. Further, certain prior art references explicitly or implicitly reference other prior art references, share common authors or inventors, were published in the same journals, were compiled by a common author of a compilation or reference book, were presented at the same conferences, and/or were developed at common companies, schools, or organizations, which

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would motivate one of ordinary skill in the art to combine them. These references are within the field of the Asserted Patents and are directed to similar subject matter within the field. Additionally, the references, and any products, devices, or processes described in the references, existed and/or were invented in the same time period providing further motivation for combination. These disclosures were provided without prejudice to any arguments or objections concerning the relevance of motivation to combine in connection with any invalidity contentions.

Defendants reserve the right to further specify the motivations to combine the prior art in response to positions that Plaintiff may take later in this case and as discovery, including third party discovery, proceeds. Defendants may rely on any and all portions of the prior art, other documents, and expert testimony to establish that a person of ordinary skill in the art would have been motivated to modify or combine the prior art so as to render the claims invalid as obvious. Moreover, Defendants reserve the right to rely on later identified sources of information, including but not limited to witness testimony and other discovery, to establish the state of the art in the relevant time frame pertaining to the Asserted Patents.

Additionally, Defendants note that Plaintiff has neither provided any contention that secondary considerations of non-obviousness exist for any Asserted Patent nor provided any evidence of such secondary considerations. Defendants are not aware of any evidence supporting the existence of any such secondary considerations. This lack of evidence further renders the Asserted Claims obvious. Proving any such secondary considerations is Omni's burden. *See, e.g.*, *ZUP, LLC v. Nach Mfg., Inc.*, 896 F.3d 1365, 1373 (Fed. Cir. 2018) ("[A] patentee bears the burden of production with respect to evidence of secondary considerations of nonobviousness."). To the extent Omni is permitted to introduce contentions and/or evidence concerning secondary considerations in the future, Defendants reserve all rights to rebut those contentions if and when

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Omni identifies them. In the meantime, Defendants note the complete lack of any such evidence in the record. Moreover, Defendants further contend that, in any event, the evidence of obviousness for each asserted claim is so overwhelming that secondary considerations are necessarily insufficient to rebut Defendants' showing. *See, e.g.*, *Ohio Willow Wood Co. v. Alps South, LLC*, 735 F.3d 1333, 1344 (Fed. Cir. 2013) ("[W]here a claimed invention represents no more than the predictable use of prior art elements according to established functions, as here, evidence of secondary indicia are frequently deemed inadequate to establish non-obviousness.").

While Defendants reserve the right to rely on any combination of the references reflected in their charts or incorporated herein by reference, Defendants provide the following exemplary and non-exhaustive references and/or combinations evidencing invalidity of the claims of the Asserted Patents. The combinations of prior art listed below render obvious the Asserted Claims under the proper construction of the claims and/or under Plaintiff's apparent interpretation of the claims as set forth by Plaintiff in its Complaint and Infringement Contentions.

1. U.S. Patent No. 9,055,868

Pursuant to P.R. 3-3(a) and (b), Defendants identify in Appendix A the prior art references that render obvious the Asserted Claims of the '868 Patent and include below exemplary combinations showing the obviousness of the '868 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix A, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the '868 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix A, such reference may be combined with any other references listed in Appendix A for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the '868 Patent

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Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '868 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix A along with the knowledge of one of ordinary skill in the art to meet the limitations of the '868 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the '868 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. Defendants may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix A, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

Reservation of Rights: Moreover, as mentioned above, Defendants have not yet completed their search or discovery concerning additional prior art. As such, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating

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combinations as appropriate, and Defendants reserve the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '868 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. Defendants further believe that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co.*, 869 F.3d 1336, 1344 (Fed. Cir. 2017). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, Defendants identify motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix A would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were

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only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix A would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '868 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix A is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

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Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix A because all of these references relate to the same area of technology and/or are from analogous art. The '868 Patent Asserted Claims are directed to a diagnostic system comprising a light source, a software application capable of operating on a control system, and a host. '868 Patent at Abstract. The '868 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the '868 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the '868 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to wirelessly collecting and processing physiological information using a light source and related features.

Demand and Market Forces: For example, market forces suggested a demand for wirelessly collecting and processing physiological information using a light source, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions

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of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the '868 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the '868 Patent, there are a finite number of approaches for wirelessly collecting and processing physiological information using a light source. For example, as of the priority date of the '868 Patent, a POSITA would have been very familiar with basic elements of the '868 Patent's claims such as devices using light passing through a user's body, including blood, to measure physiological information; semiconductor diodes; software; the wireless transmission of data, including via mobile phones and the internet; tracking location of a remote device; differing inputs to a computing system, including voice commands, touchscreens, keypads, etc. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the '868 Patent's claims does not render them novel or non-obvious.

There are significant similarities in subject matter and objectives for each of many references used in these contentions for the '868 Patent.

Wireless Physiological Monitoring References: For example, charted reference Mault, as well as numerous other references such as Kumar, Nihtila, Brown, and Quy all include teachings related to wirelessly collecting and analyzing physiological data, including data known to be collected using spectroscopy. These references provide numerous methods for collecting physiological data, as well as different methods for wirelessly transmitting and processing the data.

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For example, Mault teaches "a system embodiment comprising an electronic device 10, a blood glucose sensor 12, a physical activity monitor 14, an insulin pump 16, a communications network 20, and a remote computer system 22." Mault at [0069]. Mault further teaches that "[e]lectronic device 10 can be carried by the person, for example a portable computer, personal digital assistant (PDA), wireless phone with computational functionality, visor-mounted device, or other device" and "[s]ensor 12 can be carried by the person and provides blood glucose measurements at intervals." Mault at [0069]-[0070]. Mault teaches that "using a non-invasive spectroscopic technique, the PDA/module combination may be placed against part of the body to obtain a blood glucose reading." Mault at [0073]. Kumar teaches "system architecture 100 for network-based monitoring of data from a patient-side physiological collecting device . . . includ[ing] one or more patient-side devices 102 for collecting data from a patient/client, one or more provider-side devices 104, and an engine implemented on a central server 106." Kumar at [0067]. Kumar further teaches that "[t]he system may be adapted to include web-enabled spirometers and oximeters, allowing healthcare practitioners to perform remote spirometry and oximetry tests." Kumar at [0072]. Kumar also teaches that "[t]he patient-side device may then be connected via a computing device 110, such as a computer, handheld devices such as personal digital assistants (PDAs) and pocket PCs . . . ." Kumar at [0072]. Nihtila teaches "a system for acquiring physiological data from a user and communicating the physiological data via a mobile terminal to a network server for integration into a virtual physiological model established for the user in accordance with an embodiment of the present invention." Nihtila at [0035]. Nihtila further teaches that "[t]he physiological data communicated from the mobile terminal 122 to the network 124 is routed to a server 126 which is configured to accept and process this data. . . . and executes processing software that, in general, operates on the physiological data received from each of a number of users." Nihtila at [0038].

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Brown teaches "blood glucose monitor 16 operates in conjunction with data management unit 10 and handheld microprocessor unit 12 to: (a) perform a test or calibration sequence in which tests are performed to confirm that the system is operating properly; and, (b) perform the blood glucose test sequence in which blood glucose meter 16 senses the user's blood glucose level. Brown at 20:28-67. Brown further teaches that "each apparatus may be placed in communication with server 2018 via wireless communication networks, cellular networks, telephone networks, or any other network which allows each apparatus to exchange data with server 2018." Brown at 25:12-25. Quy is titled "Method and Apparatus for Health and Disease Management Combining Patient Data Monitoring with Wireless Internet Connectivity." Quy at Title. Quy teaches "[t]he system includes a wireless health-monitoring apparatus ('WHMA') 10 . . . [which] is linked in a wireless fashion to a wireless connection point of presence ("POP") 19, the same including at least a base station antenna 15 coupled to a server 17." Quy at 6:29-32. Quy teaches "[s]erver 17 is in turn connected to the wired, or even a wireless (not shown) Internet 21, which may include the World Wide Web." Quy at 6:33-35.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that collect and transmit physiological data. These methods are known to be effective in collecting and transmitting data. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of collecting and transmitting physiological data.

Physiological Monitoring Using Spectroscopy References: For example, charted

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reference Mault, as well as numerous other references such as Jeng[8], Pologe, Shigeki, Kumar, Nihtila, Quy, Abreu, and Scharf. all include teachings related to physiological monitoring using spectroscopy. These references provide numerous methods for measuring physiological information, such as blood glucose levels and blood oxygenation, using measurements of light. For example, Mault teaches "sensor 12 may use spectroscopic detection of a glucose oxidase reaction . . . and may also use in-vivo spectroscopy techniques to measure blood glucose." Mault at [0073]. Jeng discloses "a method and apparatus for measuring the concentration of an analyte of interest, e.g. glucose, in blood non-invasively, i.e., without penetrating the skin or obtaining a biological sample from the body of a patient." Jeng at 4:28-39. Jeng further discloses that "[l]ight passing through the body part 'B' is transmitted through an aperture 49 and then through a lens system 50 to deliver light to a dispersive element 52." Jeng at 6:57-7:4. Pologe discloses "a system for performing photoplethysmographic measurements using wavelength division multiplexing." Pologe at 4:20-32. Pologe further discloses that "[t]he received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood." Pologe at 4:33-54. Shigeki discloses a "glucose sensor" that "measures the blood glucose concentration of blood flowing through the microvessels in the earlobe 4 of the human body." Shigeki at [0009]. Shigeki further discloses that "[t]he volume of blood flow is measured using the Doppler effect, so infrared light, which has good transmissibility through biological tissue, is used to minimize the attenuation of light reflected by hemoglobin." Shigeki at [0009]. Kumar discloses that "[t]he patient-side device is located with a patient and can be any device that gathers physiological data from the patient."

[8] Mault incorporates Jeng by reference (*see* Mault at [0011], [0073]), thus, references to Jeng should be understood to be references to Mault and/or Jeng.

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Kumar at [0071]. Kumar further discloses that "[t]he system may be adapted to include web-enabled spirometers and oximeters, allowing healthcare practitioners to perform remote spirometry and oximetry tests." Kumar at [0203]. Nihtila discloses "systems and methods for using mobile communication techniques to enhance an understanding of the physiological state of an individual based on physiological information acquired from the individual in real-time." Nihtila at [0024]. Nihtila firther discloses that "a physiological data acquisition system of the present invention can include a blood sensing device 211 . . . [which] can be used to measure a number of blood related parameters," including "oxygen saturation, oxygen consumption, blood chemistry, and blood pressure, for example." Nihtila at [0054]. Quy teaches "while various types of medical devices have been mentioned, numerous other types may also be used in the embodiments of the invention, including pulse oximeters, syringe drivers, infusion pumps, spirometers, ventilators, anesthesia monitors, and so on." Quy at 12:51-13:22. Abreu teaches "FIG. 100(C) shows a schematic block diagram of one preferred far-infrared spectroscopy measuring apparatus of the present invention." Abreu at [1159]. Abreu further teaches "[b]esides near-infrared spectroscopy, the present invention provides superior results and higher signal to noise ratio when using any other form of electromagnetic radiation such as for example mid-infrared radiation, radio wave impedance, photoacoustic spectroscopy, Raman spectroscopy, visible spectroscopy, ultraviolet spectroscopy, fluorescent spectroscopy, scattering spectroscopy, and optical rotation of polarized light as well as other techniques such as fluorescent (including Maillard reaction, light induced fluorescence, and induction of glucose fluorescence by ultraviolet light), colorimetric, refractive index, light reflection, thermal gradient, Attenuated Total Internal Reflection, molecular imprinting, and the like. Abreu at [0276]. Scharf teaches "[a] reflectance pulse oximeter that determines oxygen saturation of hemoglobin using two sources of electromagnetic radiation in the green optical

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region, which provides the maximum reflectance pulsation spectrum." Scharf at Abstract. Scharf further teaches "[t]he oximeter 10 of the present invention comprises two emitters of green light 12, 14 that illuminate a volume of intravascular blood 4." Scharf at 4:8-22.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that measure physiological information, such as blood glucose levels and blood oxygenation, using measurements of light. These methods use light to measure physiological information. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological information, such as blood glucose levels and blood oxygenation, using measurements of light.

Physiological Monitoring with Lenses References: For example, charted reference Jeng, as well as numerous other references such as Pologe, Shigeki, and Scharf all include teachings related to using light with lens systems to collect physiological data. These references provide numerous methods for collecting physiological data using spectroscopy, including using systems with lenses. For example, Jeng teaches that "[t]he body part, e.g., a finger, earlobe, is positioned at the place where the beam from the source of light is focused. Light passing through the body part is transmitted through an aperture 24 and then through a lens system 25 to deliver light to the detector 20." Jeng at 6:31-44. Jeng further discloses that "Light passing through the body part 'B' is transmitted through an aperture 49 and then through a lens system 50 to deliver light to a dispersive element 52." Jeng at 6:57-7:4. Pologue discloses that "the WDM coupler can include any of a number of coupler types, such as those using lenses, prisms, interference filters, diffraction gratings, or butt coupling." Pologe at 3:43-55. Shigeki discloses that "[t]he wavelength of the light

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outputted from the first semiconductor laser 1 is 1.55 μm, which is within the glucose absorption wavelength band." Shigeki at [0009]. Shigeki further discloses that the light "passes through the earlobe 4 and is received by the first photodetector 20." Shigeki at [0009]. Abreu teaches "[t]he light radiation 2302 can be directly emitted from a light source 2300 and directly collected by a photodetector 2318, or the light radiation 2302 can be delivered and collected using optic fiber cables." Abreu at [1086]. Abreu further teaches "[a]n interface lens system can be used to convert the rays to spatial parallel rays, such as from an incident divergent beam to a spatially parallel beam." Abreu at [1086]. Scharf teaches "[s]uitable optical filters include custom-made molded acrylic aspheric lens/filters having peak wavelengths of 560 nm and 580 nm, respectively, and which have bandwidths of less than 5 nm, which are available from Innovations In Optics, Inc., address 38 Montvale Avenue, Suite 215, Storeham, Mass. 02180, (716) 279-0806." Scharf at 4:22-37. Scharf further teaches "Although shown as flat surfaces, face pieces 16, 18, and 91 can alternatively be shaped to form discrete lenses (not shown) to focus the radiant energy from the LEDs 13a-13d and 15a-15d onto the skin 2 and into the blood 4 and from the skin 2 onto the photodiode 26, 62." Scharf at 8:59-65.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that measure physiological information using light with a lens system. These methods use light with a lens system to measure physiological information. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological information using light with a lens system.

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Wavelength Division Multiplexing References: For example, charted reference Pologe, as well as numerous other references such as Jeng, Abreu, and Scharf all include teachings related to using wavelength division multiplexing to measure physiological information. These references provide numerous methods for using wavelength division multiplexing to measure physiological information, particularly relating to blood measurements. For example, Pologe teaches "the present invention relates to a system for performing photoplethysmographic measurements using wavelength division multiplexing." Pologe at 4:20-32. Pologe further discloses "the WDM coupler is capable of producing a wavelength multiplexed pulse on the single light guide that includes the spectral contents of all of the multiple light pulses. In this regard, the WDM coupler can include any of a number of coupler types, such as those using lenses, prisms, interference filters, diffraction gratings, or butt coupling. In addition, active WDM couplers can also be used." Pologe at 3:43-55. Jeng discloses that "[t]he band-pass filter set 14 selects one desired wavelength at a time by rotating the set to place a given filter in the path of the beam." Jeng at 6:11-30. Jeng further discloses that "[a] lens system 47 is used to focus the light from the beam splitter onto the detector 48." Jeng at 6:45-56. Jeng discloses that "[l]ight passing through the body part 'B' is transmitted through an aperture 49 and then through a lens system 50 to deliver light to a dispersive element 52." Jeng at 6:57-7:4. Abreu teaches "[a] variety of radiation sources 2300 can be used in the present invention including LEDs with or without a spectral filter, a variety of lasers including diode lasers, halogen lights and white light sources having maximum output power in the near infrared region with or without a filter, and the like . . . ." Abreu at [1085]. Abreu further teaches "[t]he contact device filter system allowed passage of the glucose band which is used as a reference measuring point while simultaneously measuring thermal energy absorption outside the glucose band." Abreu at [1166]. Scharf teaches "[d]epending on the particular green light sources chosen, green optical

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filters 16, 18 might be needed. For example, if the Toshiba Ltd. part nos. TLGA183P and TLPGA-183P are used as green LEDs 13, 15 then narrow-band optical filters 16, 18 need to be used." Scharf at 4:22-37.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that use wavelength division multiplexing to measure physiological information. These methods use principles of wavelength division multiplexing to measure physiological information. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of using wavelength division multiplexing to measure physiological information.

Semiconductor Diode References: For example, charted reference Jeng, as well as numerous other references such as Pologe, Shigeki, Abreu, and Scharf all include teachings related to using semiconductor diodes to measure physiological information. These references provide numerous methods for using semiconductor diodes to measure physiological information, particularly information related to a subject's blood. For example, Jeng teaches that "[t]he light sources are either laser diodes or light emitting diodes." Jeng at 15:1-27. Pologe teaches that "[t]he plurality of separate emitters includes multiple separate light sources, such as light emitting diodes (LEDs) and laser diodes." Pologe at 3:1-17. Shigeki teaches that "[t]he wavelength of the light outputted from the first semiconductor laser 1 is 1.55 μm, which is within the glucose absorption wavelength band" Shigeki at [0009]. Abreu teaches "[a] variety of radiation sources 2300 can be used in the present invention including LEDs with or without a spectral filter, a variety of lasers including diode lasers, halogen lights and white light sources having maximum output power in

the near infrared region with or without a filter, and the like . . . ." Abreu at [1085]. Scharf teaches "The green light sources 12, 14 are shown schematically as including light emitting diodes (LEDs) 13, 15 in FIG. 1; however, other green light sources can be used, such as laser diodes, filtered white light sources, filtered broad-band LEDs, etc. Suitable LEDs 13, 15 include part. nos. TLGA-183P (peak wavelength 574 nm) and TLPGA-183P (peak wavelength 562 nm) from Toshiba Ltd. through various sources, such as Marktech International, 5 Hemlock Street, Latham, N.Y. 12110, (518) 786-6591." Scharf at 4:8-22.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that use semiconductor diodes to measure physiological information. These methods use semiconductor diodes to measure physiological information. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological information.

Software Application References: For example, charted reference Mault, as well as numerous other references such as Jeng, Pologe, Shigeki, Kumar, Nihtila, Brown, Quy, Abreu, and Scharf all include teachings related to using software to analyze the collected physiological data. These references provide numerous methods for using software to analyze the collected physiological data, including generating a status of a user based on the physiological data. For example, Mault teaches that "FIG. 19 shows a flowchart representing a software program running on a computing device." Mault at [0187]. Mault further teaches that "Box 516 corresponds to performing a blood test at intervals, and providing the data to a glycemic response algorithm." Mault at [0187]. Mault teaches that "[t]he PDA has a software program, such as a calorie

management program, having a glycemic response algorithm for the subject." Mault at [0109]. Jeng teaches that "[t]he computer controls the software operation for collecting data and storing measurement readings as a data file." Jeng at 6:31-44. Pologe teaches that "The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood." Pologe at 4:33-54. Pologe further teaches that "[p]rocessing methods to determine the blood analyte levels are known and, therefore, will not be discussed further." Pologe at 4:33-54. Shigeki teaches that "[i]n the arithmetic control circuit 8, calculations are performed to calculate the amount of glucose using the relationship between glucose concentration values previously written to the EEPROM and the photodetector output values, and the relationship between glucose solution temperatures and the photodetector output values." Shigeki at [0012]. Kumar teaches that "[t]he present invention may be implemented on a program or code that can be stored in a computer-readable (or electronically-readable) medium." Kumar at [0087]. Kumar further teaches that "[t]he data interpretation and analysis module 114 is used to interpret the data stream from the client-side device, perform mathematical analysis on the data using FFT, DFT, etc., and generate statistics." Kumar at [0075]. Nihtila teaches that "The processing software integrates currently or recently acquired physiological data into the user's virtual physiological model (i.e., avatar)." Nihtila at [0038]. Nihtila further teaches that "The processing software further computes fitness data (FD) of various types, including, textual, graphical, animation, audio, video, or other form of fitness data." Nihtila at [0040]. Brown teaches that "[w]hen inserted in the handheld microprocessor unit, the program cartridge provides the software necessary (program instructions) to program the handheld microprocessor unit for operation with the microprocessor-based data management unit." Brown at 6:18-45. Brown further teaches that "Remotely Programmable

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Patient Apparatus 320 comprises a Patient Interaction Unit 322, which is connected through a patient communication network 324 to a Patient Data Management Unit 326." Brown at 35:50-36:8. Quy teaches "[a]pplication 62 may include an algorithm 63 for analyzing data from the HMD, and either application 62 or algorithm 63 may optionally access data from an external data source 74 and may further consult an artificial intelligence system 76." Quy at 8:9-14. Quy further teaches "wireless application 70 may correspondingly send a large amount of health data to server application 62." Quy at 8:47-62. Abreu teaches "[s]uitable analyzers include modified Fourier Transform Infrared (FTIR) spectrometers with chemometric software packages. Those are available from the PerkinElmer Corporation (Wellesley, Mass.) and Thermo Nicolet Company (Madison, Wis.)." Abreu at [1103]. Abreu further teaches "[p]rocessor 2324 can contain or be connected to a memory unit 2326 which can store data related to calibration, patient's measurement data, reference data, suitable algorithms, and the like." Abreu at [1083]. Scharf teaches "[a] reflectance pulse oximeter that determines oxygen saturation of hemoglobin using two sources of electromagnetic radiation in the green optical region, which provides the maximum reflectance pulsation spectrum." Scharf at Abstract. Scharf further teaches "the processor 30 collects data in the form of a digitized signal, calculates a coefficient for the oxygen saturation value from the digitized signal, determines the final saturation value by reading the saturation value for the calculated coefficient from a look-up table stored in memory, and then causes the display(s) 38, 40 to display a visual image corresponding to the final saturation value or other oximetry data." Scharf at 11:5-14.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that use software to analyze the collected physiological data. These methods use software to analyze the collected physiological data,

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including generating a status of a user based on the physiological data. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of using software to analyze the collected physiological data.

Touch Screen, Voice, and Manual Inputs References: For example, charted reference Mault as well as numerous other references such as Pologe, Kumar, Nihtila, Brown, and Quy all include teachings related to receiving touch screen, voice, or manual input to the system for measuring physiological data. These references provide numerous methods for receiving various inputs to systems that measure physiological data. For example, Mault teaches that "Other data entry mechanisms can be used, such as a stylus, touch pad, tracker device, biofeedback system, roller-jog dial, voice recognition, and the like." Mault at [0109]. Mault also teaches that "[t]he computer [which can be a PDA] can have a display, a microprocessor, memory (in the form of RAM, ROM, and a data storage device), and data entry mechanisms such as a keyboard, buttons, stylus, voice entry, roller-jog dial, track ball, finger tracking device, and the like." Mault at [0121]. Pologe discloses that "[t]he main test unit 12 includes: . . . and an input device 34, such as a keypad or a touch screen, for allowing the user to input commands and other information to the processor unit 28." Pologe at 4:63, 5:9. Kumar teaches that "the system allows for the real-time streaming of raw, interpreted, and processed physiological data as well as textual/audio/video data from a patient/client to a health care provider." Kumar at [0010]. Nihtila teaches that "the user can input weight, height, age, gender, and other physical and personal information to the user's virtual physiological model via the mobile terminal's user interface 216." Nihtila at [0046]. Brown teaches that "the user input buttons may be replaced by switches, keys, a touch sensitive display screen, or

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any other data input device." Brown at 26:1-8. Brown further teaches "the patient interaction unit is a palm-top computer, the display means being provided by a display screen of the palm top computer, and the patient interaction unit input device is a palm-top computer input device such as a touch screen." Brown at claim 2. Brown teaches "the user interface includes a speech synthesizer for audibly communicating the queries and a speech recognizer for receiving spoken responses to the queries." Brown at 9:47-52. Quy teaches "[t]he deployment of voice processing technology may be used to enable an even more convenient user interface: i.e., one to which patients can talk." Quy at 4:62-65. Quy further teaches "[t]hese applications may accept as inputs data from a sensor 24 as well as from a manual input 36." Quy at 7:61-8:8.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that receiving touch screen, voice, or manual input to the system for measuring physiological data. These methods allow the systems to receive touch screen, voice, or manual input to the system. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of receiving touch screen, voice, or manual input to the system for measuring physiological data.

Remote Server with Storage References: For example, charted reference Mault as well as numerous other references such as Kumar, Nihtila, Brown, Quy, Abreu, and Scharf all include teachings related to using remote systems, such as servers, to store and/or process physiological information. These references provide numerous methods for using remote systems, such as servers, to store and/or process physiological information. For example, Mault teaches "[t]he portable computing device 30 is in linked to a communications network 52, allowing

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communication a remote computer system 54, which may be located at the person's home, doctor's office, or other remote location." Mault at [0079]. Mault teaches that "[a] remote server system 56 is also accessible through the communications network 52, and can be used to store a database of physiological parameters, activity, and diet relating to the person, for medical, nutritional, or computer expert system analysis." Mault at [0079]. Mault teaches that "[a] global positioning system (GPS) may also be added to the PDA, to facilitate medical rescue in an emergency." Mault at [0077]. Kumar teaches "the system includes one or more patient-side devices 102 for collecting data from a patient/client, one or more provider-side devices 104, and an engine implemented on a central server 106." Kumar at [0067]. Kumar teaches "the data may be stored in a secured storage device at the central server for later access, replay, and/or analysis." Kumar at [0083]. Nihtila teaches that "there is illustrated a system for acquiring physiological data from a user and communicating the physiological data via a mobile terminal to a network server for integration into a virtual physiological model established for the user in accordance with an embodiment of the present invention." Nihtila at [0035]. Nihtila teaches "the mobile terminal 122 operates effectively as a modem to facilitated the transfer of acquired physiological data between the physiological sensor device, mobile terminal 122, network 124, and server 126 in real-time." Nihtila at [0044]. Brown teaches "[m]onitoring application 2048 is a controlling software application executed by server 2018 to perform the various functions described below." Brown at 27:11-14. Quy teaches "[s]erver 22 has a base server application 62 with which the same calculates or provides a response based at least in part on data from WHMA 10." Quy at 8:9-14. Quy further teaches "[i]t should also be noted that each of application 62, algorithm 63, external data source 74, or AI system 76, may physically reside on more than one server, e.g., on an array of servers for, e.g., storage or multiple processing purposes." Quy at 8:40-46. Abreu teaches "[t]he signal can

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be communicated by wires or radio telemetered to an externally placed receiver. The signal can then be processed, analyzed and stored." Abreu at Abstract; *see also* Abreu at [0099]. Scharf teaches "[t]he processor 30 and the remote display 40 are placed in circuit communication via a transmitter 42 and receiver 44." Scharf at 7:48-67. Scharf further teaches "the processor 30 is also in circuit communication with a remote display 40 to display a second visual image corresponding to the oximetry data." Scharf at 7:38-47.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that use remote systems, such as servers, to store and/or process physiological information. These methods use remote systems, such as servers, to store and/or process physiological information Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of using remote systems, such as servers, to store and/or process physiological information.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix A with any other reference or references listed in Appendix A along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the '868 Patent.

For example, and without limitation, the Asserted Claims of the '868 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) <u>Mault Combined with Jeng, Pologe, Shigeki, Abreu and/or Scharf</u>

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A POSITA would have had reason to combine Mault with any one of Jeng, Pologe, Shigeki, Abreu and/or Scharf all of which relate to systems and methods for obtaining physiological measurements of a user. Each of Mault, Jeng, Pologe, Shigeki, Abreu, and Scharf relate to obtaining physiological measurements of a user, including blood measurements obtained by using light. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Jeng, Pologe, Shigeki, Abreu, and Scharf provide means—not necessarily expressly present in all other references—for measuring physiological data of a user using light. A POSITA would have understood that the systems and methods for Jeng, Pologe, Shigeki, Abreu, and Scharf were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for Jeng, Pologe, Shigeki, Abreu, and Scharf provide improvements such as advances in measuring physiological data of a user using light. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological data of a user using light would commonly be combined with a wireless, wearable system, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for measuring physiological data of a user using light, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Kumar Combined with Jeng, Pologe, Shigeki, Abreu, and/or Scharf

A POSITA would have had reason to combine Kumar with any one of Jeng, Pologe, Shigeki, Abreu and/or Scharf all of which relate to systems and methods for obtaining

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physiological measurements of a user. Each of Kumar, Jeng, Pologe, Shigeki, Abreu, and Scharf relate to obtaining physiological measurements of a user, including blood measurements obtained by using light. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Jeng, Pologe, Shigeki, Abreu, and Scharf provide means—not necessarily expressly present in all other references—for measuring physiological data of a user using light. A POSITA would have understood that the systems and methods for Jeng, Pologe, Shigeki, Abreu, and Scharf were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for Jeng, Pologe, Shigeki, Abreu, and Scharf provide improvements such as advances in measuring physiological data of a user using light. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological data of a user using light would commonly be combined with a wireless, wearable system, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for measuring physiological data of a user using light, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) Nihtila Combined with Jeng, Pologe, Shigeki, Abreu, and/or Scharf

A POSITA would have had reason to combine Nihtila with any one of Jeng, Pologe, Shigeki, Abreu and/or Scharf all of which relate to systems and methods for obtaining physiological measurements of a user. Each of Nihtila, Jeng, Pologe, Shigeki, Abreu, and Scharf relate to obtaining physiological measurements of a user, including blood measurements

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obtained by using light. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Jeng, Pologe, Shigeki, Abreu, and Scharf provide means—not necessarily expressly present in all other references—for measuring physiological data of a user using light. A POSITA would have understood that the systems and methods for Jeng, Pologe, Shigeki, Abreu, and Scharf were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for Jeng, Pologe, Shigeki, Abreu, and Scharf provide improvements such as advances in measuring physiological data of a user using light. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological data of a user using light would commonly be combined with a wireless, wearable system, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for measuring physiological data of a user using light, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iv) Mault, Kumar, Nihtila, Brown, and/or Quy, Combined with any of the References Disclosing Remaining Features

A POSITA would have had reason to combine references Mault, Kumar, Nihtila, Brown, and/or Quy with any one of the references disclosing physiological monitoring using spectroscopy; physiological monitoring with lenses; wavelength division multiplexing; the use of semiconductor diodes; software applications; touch screen, voice, and manual inputs; and remote servers with storage (collectively, the "remaining features") all of which relate to systems and methods for obtaining physiological measurements of a user, including blood measurements.

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Each of the references teaching the remaining features relate to obtaining physiological measurements of a user, including blood measurements, using light. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the references teaching the remaining features provide means—not necessarily expressly present in all other references—for obtaining physiological measurements of a user, including blood measurements, using light. A POSITA would have understood that the systems and methods for the references teaching the remaining features were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for the references teaching the remaining features provide improvements such as specific methods and systems for obtaining physiological measurements using light. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for a wireless system for collecting and processing physiological data would commonly be combined with obtaining physiological measurements (for example, blood glucose levels and blood oxygenation) using light, and thus a POSITA would have been motivated to combine the teachings of these references. Two non-limiting examples of such combinations, which are provided for illustrative purposes only, include Brown in view of Jeng, Pologe, Shigeki, Abreu, and/or Scharf and Quy in view of Jeng, Pologe, Shigeki, Abreu, and/or Scharf. The combinations would apply known techniques for obtaining physiological measurements using light, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combinations would further be "obvious to try," because they would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

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Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits A1 through A10 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-A, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the wireless physiological monitoring references; the physiological monitoring using spectroscopy references; the physiological monitoring with lenses references; the wavelength division multiplexing references; the semiconductor diode references; the software application references; the touch screen, voice, and manual inputs references; the remote server with storage references, for the reasons discussed above.

2. U.S. Patent No. 9,651,533

Pursuant to P.R. 3-3(a) and (b), Defendants identify in Appendix B the prior art references that render obvious the Asserted Claims of the '533 Patent and include below exemplary combinations showing the obviousness of the '533 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix B, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the '533 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix B, such reference may be combined with any other references listed in Appendix B for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the '533 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '533 Patent

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Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix B along with the knowledge of one of ordinary skill in the art to meet the limitations of the '533 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the '533 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. Defendants may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix B, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

Reservation of Rights: Moreover, as mentioned above, Defendants have not yet completed their search or discovery concerning additional prior art. As such, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendants reserve the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the

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extent not anticipated, the ’533 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. Defendants further believe that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit’s “rigid” application of the teaching, suggestion, or motivation to combine test, instead espousing an “expansive and flexible” approach); *Apple Inc. v. Samsung Elecs. Co*., 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co*., 869 F.3d 1336, 1344 (Fed. Cir. 2017). Indeed, the Supreme Court held that a person of ordinary skill in the art is “a person of ordinary creativity, not an automaton” and “in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle.” *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, Defendants identify motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix B would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix

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B would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '533 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix B is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix B because all of these references relate to the same area of technology and/or are from analogous art. The '533 Patent

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Asserted Claims are directed to an optical measurement system with a personal device and a remote device. '533 Patent at Claim 5. The '533 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the '533 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the '533 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references concerning features related to known techniques for increasing the signal-to-noise ratio and known components and functionalities of personal devices and remote devices.

Demand and Market Forces: For example, market forces suggested a demand for improving signal-to-noise ratio and wirelessly transmitting information from optical measurement systems to devices such as personal devices and remote devices, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already

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known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the ’533 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the ’533 Patent, there are a finite number of approaches for increasing signal-to-noise ratio and communicating information to other devices. For example, as of the priority date of the ’533 Patent, a POSITA would have been very familiar with basic elements of the ’533 Patent’s claims such as increasing a light intensity, increasing a pulse rate, using a plurality of lenses to direct an output optical beam, and communicating information with a personal device and a remote device. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the ’533 Patent’s claims does not render them novel or non-obvious.

There are significant similarities in subject matter and objectives for each of many references used in these contentions for the ’533 Patent.

References disclosing techniques for increasing signal-to-noise ratio: For example, charted reference Basu, as well as numerous other references such as Lisogurski, Carlson, LeBoeuf, and Park all include teachings related to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. These references provide numerous methods for increasing a light intensity and increasing a pulse rate of an LED. For example, Basu teaches that “[t]o maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector. In the OPS 10, the LED intensity and modulation frequencies are programmable through the serial interface. In the case of the Vishay VCNL4000, the intensity is programmable

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from 10-200 mA in 10 mA increments." Basu at [0048]. Lisogurski teaches "that modulation of the light drive signal . . . may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof" and that "[t]he system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio." Lisogurski at 27:44-55, 9:46-60. Carlson teaches that the "frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio." Carlson at [0069]. LeBoeuf teaches that "the intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight" and that "it is important to consider the emitter pulsing frequency and sampling approach" because "choosing a frequency that is too low may result in unsatisfactory subtraction." LeBoeuf at [0123], [0139]. Park teaches that "the light source intensity may be increased to maintain the output signal from the light detector within a desired range of output values." Park at 16:8-20.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with improving signal-to-noise ratio in optical measurement systems. These methods are known to be effective in improving the signal-to-noise ratio for such systems, and merely modulate the functioning of the existing LEDs in each system. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other

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references in order to better achieve their common goals of improving signal-to-noise ratio.

References disclosing lenses: For example, charted reference Basu, as well as numerous other references such as Carlson, LeBoeuf, Park, and Sakai all include teachings related to using a plurality of lenses configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. These references provide numerous methods for using lenses to direct an optical output beam. For example, Basu teaches that "[e]ach of the LEDs is separated from the photo detector by an optical barrier." Basu at [0087]. Carlson teaches "a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise—and signal/Background ratio" Carlson at [0014]. LeBoeuf teaches that "the at least one sensor module include a lens positioned above at least one of the optical emitter and filter. The lens may include respective first and second portions configured to matingly engage respective first and second apertures in the light-opaque material." LeBoeuf at [0022]. Park teaches that "the transmissive structures may employ a material and/or optical design to facilitate low light loss (for example, a lens) thereby improving SNR of the photo detector and/or reducing power consumption of the light emitter(s) and/or light detector(s)." Park at 11:32-57. Sakai teaches that "[i]nfrared light or green light is emitted to the human body via a light transmitting plate 2029." Sakai at 28:01-32.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with using lenses to direct an optical output beam. These methods are known to be effective in directing an optical output beam using known lens structures. Moreover, to the extent that any of these references includes a feature

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not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of directing an optical output beam.

References disclosing a personal device: For example, charted reference Basu, as well as numerous other references such as Addison, LeBoeuf, Park, and Kreger all include teachings related to a personal device. These references provide numerous methods for incorporating a personal device into an optical measurement system. For example, Basu teaches "a wireless ring which combines the sensor with a Bluetooth transmitter linked to an Android application running on the user's cell phone." Basu at [0057]. Addison teaches that "[o]utput 414 may be any suitable output device such as, for example, . . . one or more display devices (e.g., monitor, PDA, mobile phone, any other suitable display device, or any combination thereof), one or more audio devices, . . . or any combination thereof." Addison at [0069]. LeBoeuf teaches that "headsets configured to monitor an individual's physiology and/or environment may be wired to a device that stores and/or processes data or there may be a combination of wired and wireless communications." LeBoeuf at [0106]. Park teaches that a "secondary device may be equipped with a display to output data obtained by the secondary device or data transferred to it by the biometric monitoring device, the external service, or a combination of data from the biometric monitoring device, the secondary device, and/or the external service." Park at 9:17-40. Kreger teaches "sensor data and measurements may be transmitted to remote medical personnel, internet servers, and others using WiFi transceiver 68, Bluetooth transceiver 72 or other RF transmitter such as for a cellular phone network. As well, the signals and measurements on the mobile 12 may be transferred via a cable connected to USB connector 28 c or docking connector 28 b to another computer storage device, over a computer network, to a personal computer, and so forth." Kreger at 7:39-46.

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A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with incorporating a personal device into optical measurement systems. These methods are known to be effective in incorporating a personal device into such systems. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of communicating with a personal device.

References disclosing a remote device: For example, charted reference Basu, as well as numerous other references such as Addison, LeBoeuf, Park, and Kreger all include teachings related to a remote device. These references provide numerous methods for incorporating a remote device into an optical measurement system. For example, Basu teaches that "[a] 'cloud-based' RPM infrastructure can actively manage cardiovascular health (Fig. 1). Using OPS technology, cardiovascular parameters can be monitored on a 24-hour ambulatory basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record." Basu at [0055]. Carlson teaches that "health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised." Carlson at [0078]. LeBoeuf teaches that "the processed energy response signal is transmitted to a remote device, for example wirelessly transmitted." LeBoeuf at [0035]. Park teaches that "the secondary device may communicate with an external service such as www.fitbit.com or server (e.g., personal computer). Communication may be achieved through wired (e.g., Ethernet, USB) or wireless (e.g., WLAN, Bluetooth, RFID, NFC, cellular) circuitry and protocols to transfer data to and/or from the secondary device." Park at 8:53-9:16. Kreger

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teaches “sensor data and measurements may be transmitted to remote medical personnel, internet servers, and others using WiFi transceiver 68, Bluetooth transceiver 72 or other RF transmitter such as for a cellular phone network. As well, the signals and measurements on the mobile 12 may be transferred via a cable connected to USB connector 28 c or docking connector 28 b to another computer storage device, over a computer network, to a personal computer, and so forth.” Kreger at 7:39-46.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with incorporating a remote device into optical measurement systems. These methods are known to be effective in incorporating a remote device into such systems. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of communicating with a remote device.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix B with any other reference or references listed in Appendix B along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the ’533 Patent.

For example, and without limitation, the Asserted Claims of the ’533 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) Basu Combined with Lisogurski, Carlson, LeBoeuf, Park, Kreger, and/or Sakai

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A POSITA would have had reason to combine Basu with any one of Lisogurski, Carlson, LeBoeuf, and Park all of which relate to systems and methods for optical measurement. Each of Lisogurski, Carlson, LeBoeuf, and Park relate to increasing signal-to-noise ratio in optical measurement systems. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Lisogurski, Carlson, LeBoeuf, and Park provide means—not necessarily expressly present in all other references—for increasing signal-to-noise ratio. A POSITA would have understood that the systems and methods for increasing signal-to-noise ratio were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for increasing intensity and pulse rate, and those using filters, provide improvements such as increasing signal-to-noise ratio. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for increasing signal-to-noise ratio would commonly be combined with increasing intensity and pulse rate, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for increasing signal-to-noise ratio, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Basu Combined with Addison and/or Kreger

A POSITA would have had reason to combine Basu with Addison, which relates to systems and methods for optical measurement. Addison and Kreger relate to incorporating personal and remote devices into systems for optical measurement. Indeed, such components and/or processes were conventional as of the time these references were known. Addison and Kreger provide means—not necessarily expressly present in all other references—for incorporating personal and

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remote devices into systems for optical measurement. A POSITA would have understood that the systems and methods for incorporating personal and remote devices into systems for optical measurement were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for incorporating personal and remote devices into systems for optical measurement provide improvements such as improved mobility and remote medical monitoring. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement would commonly be combined with personal and remote devices, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for incorporating personal and remote devices into systems for optical measurement, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) Addison, Carslon, LeBoeuf, Lisogurski, Park, Kreger, Sakai, Combined with any of the References Disclosing Remaining Features

A POSITA would have had reason to combine references Addison, Carslon, LeBoeuf, Lisogurski, Park, Kreger, or Sakai with any one of the references disclosing increasing signal-to-noise ratio, lenses, a personal device, a remote device (collectively, the "remaining features") all of which relate to systems and methods for obtaining and processing physiological measurements of a user. Each of the references teaching the remaining features relate to obtaining and processing physiological measurements of a user using light. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the references teaching the remaining features provide means—not necessarily expressly present in all other references—for obtaining and processing physiological measurements of a user. A POSITA would have

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understood that the systems and methods for the references teaching the remaining features were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for the references teaching the remaining features provide improvements such as specific methods and systems for obtaining and processing physiological measurements using light. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for a wireless system for collecting and processing physiological data would commonly be combined with obtaining physiological measurements (for example, blood glucose levels and blood oxygenation) using light, and thus a POSITA would have been motivated to combine the teachings of these references. The combinations would apply known techniques for obtaining physiological measurements using light, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combinations would further be "obvious to try," because they would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits B1 through B8 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-B, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the References disclosing techniques for increasing signal-to-noise ratio, References disclosing lenses, References disclosing a personal device, and References disclosing a remote device, for the reasons discussed above.

3. U.S. Patent No. 10,517,484

Pursuant to P.R. 3-3(a) and (b), Defendants identify in Appendix C the prior art references that render obvious the Asserted Claims of the '484 Patent and include below exemplary

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combinations showing the obviousness of the ’484 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix C, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the ’484 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix C, such reference may be combined with any other references listed in Appendix C for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the ’484 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the ’484 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix C along with the knowledge of one of ordinary skill in the art to meet the limitations of the ’484 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the ’484 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any

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of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. Defendants may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix C, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

Reservation of Rights: Moreover, as mentioned above, Defendants have not yet completed their search or discovery concerning additional prior art. As such, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendants reserve the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '484 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. Defendants further believe that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co.*, 869 F.3d 1336, 1344 (Fed. Cir. 2017). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21.

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Nevertheless, in addition to the information contained elsewhere in these contentions, Defendants identify motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix C would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix C would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '484 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix C is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the

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prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix C because all of these references relate to the same area of technology and/or are from analogous art. The '484 Patent Asserted Claims are directed to "A wearable device includes a measurement device to measure a physiological parameter adapted to be placed on a wrist or an ear of a user." '484 Patent at Abstract. The '484 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the '484 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer

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to or discuss other prior art, illustrating the close technical relationship among the prior art. For the ’484 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to wearable devices measuring physiological parameters.

Demand and Market Forces: For example, market forces suggested a demand for wearable devices for measuring physiological parameters, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the ’484 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the ’484 Patent, there are a finite number of approaches for providing a wearable device for measuring physiological parameters. For example, as of the priority date of the ’484 Patent, a POSITA would have been very familiar with basic elements of the ’484 Patent’s claims such as semiconductors, optical wavelengths, lenses, signal-to-noise ratio, detectors, analog to digital convertors, smart phones, tablets, cloud, and artificial intelligence. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the ’484 Patent’s claims does not render them novel or non-obvious.

There are significant similarities in subject matter and objectives for each of many references used in these contentions for the ’484 Patent.

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References disclosing smart phone or tablet: For example, charted reference Basu, Rulkov, Goodman, Kassim, Poeze, Terumoto, Moon, Tran, and Kreger, as well as other references such as Mault, all include teachings related to incorporating a smart phone or tablet into an optical measurement system. For example, Rulkov discloses "a device such as a personal digital assistant, laptop computer, mobile telephone, exercise equipment, or the like for display and even processing of the user's real-time vital signs information." Rulkov at 5:48-64. Basu discloses that "[i]n smart phones, for example, OPS detect when a phone is placed in a pocket, triggering touch-screen locking." Basu at [0035]. Goodman discloses "FIG. 5 shows another possible configuration of system 10 wherein processing device 14 is a PDA (e.g. Palm Pilot™) having PPG sensor 12 interfaced therein." Goodman at 13:26-42. Kassim discloses "the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is not exhaustive by any means." Kassim at 12:12-19. Poeze discloses "the patient monitor may include a display device, a network interface communicating with any one or combination of a computer network, a handheld computing device, a mobile phone, the Internet, or the like." Poeze at 2:47-60. Terumoto discloses "the wireless communication circuit 33 transmits the measurement data acquired at the measurement unit 10 (i.e., the raw data provided from the amplifier circuit 14, the processed data various processes has performed provided from the processing circuit 15, or the stored data provided from the memory 32) to the external personal computer or a cell phone." Terumoto at [0130]. Moon discloses, "FIG. 14 indicates how the wrist-worn transceiver 72 can communicate wirelessly with either a networked computer 198 (e.g. a tablet computer located at a central nursing station) or a hand-held computer 199 (e.g. a cell phone or PDA, typically carried by the medical professional)." Moon at [0107]. Tran teaches that while a patient with a wearable device is outside a mesh network range, "the wearable appliance

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communicates with the cell phone and provides information to the server 200 using the cellular connection." Tran, 34:4-30. Kreger discloses "In other embodiments, the mobile communications device can be any of a number of mobile phones such as an iPhone® or an Android® phone, a personal digital assistant (PDA) such as a Blackberry®, a portable audio playback device such as an MP3 player, a portable media playback device such as an iPod®, or a handheld tablet such as an iPad®." Kreger at 5:48-53. Mault teaches a blood glucose monitoring system including an electronic device that "can be a portable electronic device or system carried by the person, or a device or system combining multiple functionalities, such as:…a portable computer; any portable Internet access device; [or] a wireless phone…." Mault [0069]-[0070].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with incorporating a smart phone or tablet into optical measurement systems. These methods are known to be effective in incorporating a smart phone or tablet into such systems. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of communicating with a smart phone or tablet.

References disclosing lenses: For example, charted reference Carlson, Poeze, and Soller, as well as numerous other references such as LeBoeuf and Park, all include teachings related to using one or more lenses configured to receive a portion of at least one of the output optical lights and to direct a lens output light to tissue. These references provide numerous methods for using lenses to direct an optical output beam. For example, Carlson teaches "us[ing] a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g.,

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the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise—and signal/Background ratio. The increase of the S/B ratio is estimated e.g. to a factor 5." Carlson at [0014]. Poeze teaches "[using] a lens which collects attenuated light exiting the measurement site and focuses onto one or more detectors. The protrusion can advantageously include plastic, including a hard opaque plastic, such as a black or other colored plastic, helpful in reducing light noise." Poeze at 7:52-8:7. Soller teaches "a variety of different collimating elements 56 can be used in sensor 10. Exemplary collimating elements include fiber faceplates (e.g., fiber optic windows), collimating hole devices, gradient index (GRIN) lenses, fiber bundles, lens arrays, optical windows (including shaped optical windows), and other similar devices." Soller at 18:37-56.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with using lenses to direct an optical output beam. These methods are known to be effective in directing an optical output beam using known lens structures. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of directing an optical output beam.

References disclosing techniques for increasing signal-to-noise ratio: For example, charted reference Basu, Lisogurski, and Carlson, as well as numerous other references such as LeBoeuf and Park, all include teachings related to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. These references provide numerous methods for increasing a light intensity and increasing a pulse rate

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of an LED. For example, Basu teaches that "[t]o maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector. In the OPS 10, the LED intensity and modulation frequencies are programmable through the serial interface. In the case of the Vishay VCNL4000, the intensity is programmable from 10-200 mA in 10 mA increments." Basu at [0058]. Lisogurski teaches "that modulation of the light drive signal . . . may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof" and that "[t]he system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio." Lisogurski at 27:44-55, 9:46-60. Carlson teaches that the "frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio." Carlson at [0069]. LeBoeuf teaches that "the intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight" and that "it is important to consider the emitter pulsing frequency and sampling approach" because "choosing a frequency that is too low may result in unsatisfactory subtraction." LeBoeuf at [0123], [0139]. Park teaches that "the light source intensity may be increased to maintain the output signal from the light detector within a desired range of output values." Park at 16:8-20.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with improving signal-to-noise ratio in optical measurement systems. These methods are known to be effective in improving the

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signal-to-noise ratio for such systems, and merely modulate the functioning of the existing LEDs in each system. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of improving signal-to-noise ratio.

References disclosing an analog to digital converter: For example, charted reference Basu, Goodman, Lisogurski, Rulkov, Moon, Poeze, Chandrasekar, Kreger, and Sakai all include teachings related to an analog to digital converter. These references provide numerous methods for using an analog to digital converter coupled to a detector. For example, Basu discloses "a digital interface for communication with a microcontroller." Basu at [0007]. Goodman discloses "On board analog-to-digital converter A/D 44 (10 bit, 5 channel input) is used to convert the conditioned PPG signals at B and B′ into time sampled digital signals which are then provided to processing device 14. Goodman at 11:66-12:21. Lisogurski discloses a "[f]ront end processing circuitry 150 may perform various analog and digital processing of the detector signal." Lisogurski at 12:42-51. Rulkov discloses that "The microprocessor741 has a LED control715 connected to DAC702 for controlling the intensity of the LEDs737. The signal from the photodetector736 is transmitted to a high pass filter (HPF) 703 which sends it to an analog to digital converter704, and the signal from the photodetector737 is also sent directly to a second analog to digital converter704." Rulkov at 11:39-60. Moon discloses that "[a] filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG." Moon at [0091]. Poeze discloses "[f]ront-end interfaces 108 may be implemented using transimpedance amplifiers that are coupled to analog to

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digital converters in a sigma delta converter." Poeze at 40:15-27. Chandrasekar discloses "In principle, PPGs are considered simple devices; however, in practice, implementation requires a careful design involving optics (multiple paths, alignments, leakage barriers) and mixed signal electronics (transimpedance amplifiers, analog digital conversion, drivers, modulators, filters)." Chandrasekar at 1. Kreger discloses "Biosensor signals may also be received by one or more RF receivers in the dock 246 (not shown) and communicated to the mobile 212 via wired electrical connector 246, for example, to allow the wireless sensor to utilize the features of the wired audio input's anti-alias filters and analog to digital converter as will be explained in detail below." Kreger at 10:14-28. Sakai discloses "A/D converter 2013 d which converts a voltage value of analog signal into 10-bit digital value."

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with incorporating an analog to digital converter into optical measurement systems. These methods are known to be effective in incorporating an analog to digital converter into such systems. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of signal processing.

References disclosing a cloud: For example, charted references Basu and Kassim, as well as numerous other references such as Mault and US2011/0082711A1, include teachings related to using a cloud. These references provide numerous methods for communicating with a cloud. For example, Basu teaches that "a "cloud-based" RPM infrastructure can actively manage cardiovascular health. Using OPS technology, cardiovascular parameters can be monitored on a

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24-hour ambulatory basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record." Basu at [0064]. Kassim teaches that "[t]he computer platform may further be connected to network resources 2006 which connect to the Internet or other components of a local public or private network. The network resources 2006 may provide instructions and data to the computer platform from a remote location on a network 2007." Kassim, 33:34-34:19. Mault teaches "[t]he PDA can access the communications network, such as the Internet, using a wireless connection. Data can be transferred to the remote system over the communications network 20." Mault, [0077]. US 2011/0082711A1 teaches "the camera is paired with an optical character recognition module so that scanned medical forms can be converted into data that can be uploaded for synchronization at a server in a network (e.g. a cloud computing network) or stored on the personal health organizer device." At [0048].

A person of skill in the art would understand that the functionality taught in this reference could be added to other methods and systems for measuring physiological parameters. These methods provide communication with a cloud which allows for remote storage and computation on the cloud. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological parameters.

References disclosing artificial intelligence: For example, charted reference Tran, as well as other references such as Quy, include teachings related to using artificial inteligence. For example, Tran teaches "Various mathematical techniques and Artificial Intelligence (AI) analyzer can be applied. … AI approaches towards signal recognition include Artificial Neural Networks (ANN), dynamic recurrent neural networks (DRNN), fuzzy logic system, Genetic Algorithm (GA),

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and Hidden Markov Model (HMM)." Tran at 94:49-65. Quy teaches "[a]pplication 62 may include an algorithm 63 for analyzing data from the HMD, and either application 62 or algorithm 63 may optionally access data from an external data source 74 and may further consult an artificial intelligence system 76." Quy at 8:9-14.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for measuring physiological parameters. These methods provide using artificial intelligence. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological parameters.

References disclosing spatially separated detectors: For example, charted references Lisogurski, Poeze, Soller, Terumoto, and Tran, all include teachings related to using detectors that are spatially separated. These references provide numerous methods for using light detectors. For example, Lisogurski teaches that "[o]ne or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart." Lisogurski at 17:35-45. Poeze discloses that "multiple detectors are employed and arranged in a spatial geometry. This spatial geometry provides a diversity of path lengths among at least some of the detectors and allows for multiple bulk and pulsatile measurements that are robust." Poeze at 9:18-27. Soller discloses "a plurality of spectral detectors attached to the circuit board, each spectral detector being configured to analyze radiation derived from the radiation source" and depicts the

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detectors as spatially separated. Soller at 3:16-27; Fig. 34. Terumoto discloses "[t]he light sensor portions 101-1 to 101-n are located equally spaced from one another and to go round the armlet type housing 107 same as the fourth to sixth implementations." Terumoto at [0152]. Tran discloses "[t]he electrode array sensor can be a geometric array of discrete electrodes having an equally-spaced geometry of multiple nodes that are capable of functioning as sense and reference electrodes. In a typical tomography application the electrodes are equally-spaced in a circular configuration. Alternatively, the electrodes can have non-equal spacing and/or can be in rectangular or other configurations in one circuit or multiple circuits." Tran at 50:61-51:8.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that detect light. These methods provide using detectors that are spatially separated. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological parameters.

References disclosing detection system is synchronized to the light source: For example, charted reference Lisogurski, Carlson, Poeze, Kreger, and Sakai all include teachings related to detection system is synchronized to the light source. These references provide numerous methods for synchronizing detection system with the light source. For example, Lisogurski discloses "he front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals." Lisogurski at 11:33-49. Carlson discloses "[t]he basic

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idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3." Carlson at [0065]. Poeze teaches that "[a] control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 104. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 104 to follow a precise timing and consistent pattern." Poeze at 15:27-48. Kreger discloses "Thus, it is another object to provide compatible signals to the mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise and drift, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth." Kreger at 3:17-23. Sakai discloses "he A/D converter 14 operates in synchronization with the light emission timing of the driver 12, to thereby convert the pulse wave detection signal detected upon light emission from the green LED 11 a and the body motion detection signal detected upon light emission from the infrared LED 11 b into digital data, and provides these digital data, as biological information, to the information processor 20." Sakai at 5:66-6:9.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with measuring physiological parameters. These methods are known to be effective in incorporating synchronizing detection system with the light source. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked

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to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of signal processing.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix C with any other reference or references listed in Appendix C along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the ’484 Patent.

For example, and without limitation, the Asserted Claims of the ’484 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) Carlson, Lisgurski, Chandersekar, Soller, Tran, and Sakai combined with References disclosing smart phone or tablet

A POSITA would have had reason to combine references Carlson, Lisgurski, Moon, Soller, and Sakai with any one of References disclosing smart phone or tablet, all of which relate to systems and methods for incorporating a smart phone or tablet into an optical measurement system. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing smart phone or tablet provide means—not necessarily expressly present in all other references—for incorporating a smart phone or tablet into an optical measurement system. A POSITA would have understood that the systems and methods for References disclosing smart phone or tablet were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using smart phone or tablet into an optical measurement system provide improvements such as the ability to coomunicate with smart phone or tablet and/or increased processing capabilities. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using smart phone or tablet would commonly be combined with

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optical measurement system, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using smart phone or tablet, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Rulkov, Basu, Goodman, Chandersekar, Kassim, Lisogurski, Moon, Terumoto, Tran, Kreger, and Sakai combined with References disclosing lenses

A POSITA would have had reason to combine references Rulkov, Basu, Goodman, Kassim, Lisogurski, Moon, Terumoto, Tran, Kreger, and Sakai with any one of References disclosing lenses, all of which relate to systems and methods for using lenses to direct an optical output beam. Each of References disclosing lenses relate to using one or more lenses configured to receive a portion of at least one of the output optical lights and to direct a lens output light to tissue. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing lenses provide means—not necessarily expressly present in all other references—for using lenses to direct an optical output beam. A POSITA would have understood that the systems and methods for References disclosing lenses were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using lenses provide improvements such as disrecting the light to tissue. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using lenses to direct an optical output beam would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using lenses to direct an optical output beam, to wearable

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measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) Kassim, Rulkov, Goodman, Moon, Chandersekar, Poeze, Soller, Terumoto, Tran, Kreger, and Sakai combined with References disclosing techniques for increasing signal-to-noise ratio

A POSITA would have had reason to combine Kassim, Rulkov, Goodman, Moon, Poeze, Soller, Terumoto, Tran, Kreger, and Sakai with any one of References disclosing techniques for increasing signal-to-noise ratio, all of which relate to systems and methods for increasing a light intensity and increasing a pulse rate of an LED. Each of References disclosing techniques for increasing signal-to-noise ratio relate to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing techniques for increasing signal-to-noise ratio provide means—not necessarily expressly present in all other references—for increasing signal-to-noise ratio relate to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. A POSITA would have understood that the systems and methods for References disclosing techniques for increasing signal-to-noise ratio were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for increasing a light intensity and increasing a pulse rate of an LED provide improvements such as increasing signal-to-noise ratio. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for increasing signal-to-noise ratio would commonly be combined with

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optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for increasing signal-to-noise ratio, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iv) Carlson, Kassim, Soller, Chandersekar, Terumoto, and Tran combined with References disclosing an analog to digital converter

A POSITA would have had reason to combine references Carlson, Kassim, Soller, Terumoto, and Tran with any one of References disclosing an analog to digital converter, all of which relate to systems and methods for using an analog to digital converter coupled to a detector. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing an analog to digital converter provide means—not necessarily expressly present in all other references—for using an analog to digital converter coupled to a detector. A POSITA would have understood that the systems and methods for References disclosing an analog to digital converter were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using an analog to digital converter provide improvements such as ability to process a signal digitally. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using an analog to digital converter would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using an analog to digital converter, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination

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would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(v) Carlson, Rulkov, Chandersekar, Goodman, Kassim, Lisogurski, Moon, Poeze, Soller, Terumoto, Tran, Kreger, and Sakai combined with References disclosing a cloud

A POSITA would have had reason to combine references Carlson, Rulkov, Chandersekar, Goodman, Kassim, Lisogurski, Moon, Poeze, Soller, Terumoto, Tran, Kreger, and Sakai with any one of References disclosing a cloud, all of which relate to systems and methods for using a cloud. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing a cloud provide means—not necessarily expressly present in all other references—for using a cloud. A POSITA would have understood that the systems and methods for using a cloud were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using a cloud provide improvements such as remote storage and computing. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with a cloud, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using a cloud, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(vi) Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Lisogurski, Moon, Poeze, Soller, Terumoto, Kreger, and Sakai combined with References disclosing artificial intelligence

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A POSITA would have had reason to combine references Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Lisogurski, Moon, Poeze, Soller, Terumoto, Kreger, and Sakai with any one of References disclosing artificial intelligence, all of which relate to systems and methods for using artificial intelligence. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing artificial intelligence provide means—not necessarily expressly present in all other references—for using artificial intelligence. A POSITA would have understood that the systems and methods for References disclosing artificial intelligence were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using artificial intelligence provide improvements such as automation and improved processing power. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with artificial intelligence, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for artificial intelligence, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(vii) Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Kreger, and Sakai combined with References disclosing spatially separated detectors

A POSITA would have had reason to combine references Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Kreger, and Sakai with any one of References disclosing spatially separated detectors all of which relate to systems and methods for using spatially separated detectors. Indeed, such components and/or processes were conventional as of

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the time these references were known. Each of References disclosing spatially separated detectors provide means—not necessarily expressly present in all other references—for using spatially separated detectors. A POSITA would have understood that the systems and methods for References disclosing spatially separated detectors were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for spatially separated detectors provide improvements such as improved detection quality. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with spatially separated detectors, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using spatially separated detectors, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(viii) Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Soller, Terumoto, and Tran combined with References disclosing detection system is synchronized to the light source

A POSITA would have had reason to combine references Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Soller, Terumoto, and Tran with any one of References disclosing detection system is synchronized to the light source, all of which relate to systems and methods for synchronizing a detection system with a light source. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing detection system is synchronized to the light source provide means—not necessarily expressly present in all other references—for synchronizing a detection system with a light

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source. A POSITA would have understood that the systems and methods for References disclosing detection system is synchronized to the light source were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for synchronizing a detection system with a light source provide improvements such as improved detection. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with techniques for synchronizing a detection system with a light source, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for synchronizing a detection system with a light source, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits C1 through C14 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-C, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the References disclosing smart phone or tablet, References disclosing lenses, References disclosing techniques for increasing signal-to-noise ratio, References disclosing an analog to digital converter, References disclosing a cloud, References disclosing artificial intelligence, References disclosing spatially separated detectors, References disclosing detection system is synchronized to the light source, for the reasons discussed above.

4. U.S. Patent No. 10,874,304

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Pursuant to P.R. 3-3(a) and (b), Defendants identify in Appendix D the prior art references that render obvious the Asserted Claims of the ’304 Patent and include below exemplary combinations showing the obviousness of the ’304 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix D, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the ’304 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix D, such reference may be combined with any other references listed in Appendix D for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the ’304 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the ’304 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix D along with the knowledge of one of ordinary skill in the art to meet the limitations of the ’304 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the ’304 Patent obvious when the references are read in combination with each other, and/or when

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read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. Defendants may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix D, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

Reservation of Rights: Moreover, as mentioned above, Defendants have not yet completed their search or discovery concerning additional prior art, including prior art systems that may anticipate and/or render obvious the Asserted Claims (e.g., System Art).. As such, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendants reserve the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '304 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. Defendants further believe that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co.*, 869 F.3d 1336, 1344 (Fed. Cir. 2017).

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Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, Defendants identify motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix D would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix D would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '304 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

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Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix D is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix D because all of these references relate to the same area of technology and/or are from analogous art. The ’304 Patent Asserted Claims are directed to a physiological measurement system. ’304 Patent at Abstract. The ’304 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the ’304 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the

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teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the '304 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to wearable devices measuring physiological parameters.

Demand and Market Forces: For example, market forces suggested a demand for wearable devices for measuring physiological parameters, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the '304 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the '304 Patent, there are a finite number of approaches for providing a wearable device for measuring physiological parameters. For example, as of the priority date of the '304 Patent, a POSITA would have been very familiar with basic elements of the '304 Patent's claims such as semiconductors, optical wavelengths, signal-to-noise ratio, detectors, analog to digital converters, smart phones/tablets, cloud, and their configurations and/or means for the same. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the '304 Patent's claims does not render them novel or non-obvious.

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There are significant similarities in subject matter and objectives for each of many references used in these contentions for the ’304 Patent.

Reflective Surface References: For example, charted reference **LeBoeuf**, as well as numerous other references such as **Basu** and **Valencell** all include teachings related to physiological measurement systems. These references provide numerous methods for using a reflective surface in a sensor to direct the reflected light from a sample to a detector. For example, **LeBoeuf** teaches using a “cover 18” with a “cladding material 21 [which] may be reflective material” to “serve[] as a light guide that… collects light external to the earbud housing 16 and delivers the collected light to the optical detector 26”. LeBoeuf, [0103], [0107], [0115]. **Basu** teaches “[t]he battery 32 may additionally be arranged to provide a reflective surface for the light emitted by the LED 14 toward the photodiode 16.” Basu, [0088]. **Valencell** teaches “The light guiding region 2306 helps direct light to and/or from the sensor module …. In some embodiments, the light guiding region 2306 may be a reflector.” Valencell, [0152].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for physiological measurements. These methods provide the benefit of improved delivery of the light reflected from tissue to the detectors in the sensor. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

SNR Techniques: For example, charted reference **Kassim**, as well as numerous other references such as **Carlson, Basu, Lisogurski, Marbach**, and **LeBoeuf** all include teachings related to physiological measurement systems. These references provide numerous methods for

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improving signal-to-noise ratio through various methods, including increasing light intensity, increasing pulse rate, differencing detected signals, and applying multivariate techniques. For example, **Kassim** teaches "a maximum of the true Red PPG signal (devoid of ambient noise) can simply be obtained by subtracting the obtained maximum value of the Red PPG signal, obtained when the Red LED is turned on, with the obtained maximum value of the ambient PPG signal." Kassim, 22:27-23:3. **Carlson** teaches that "shift[ing] [the] spectrum of signal" can result in "increasing significantly the Signal-to-Noise and Signal-to-Background ratio" when the "frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light." Carlson, [0069]. **Basu** teaches "[t]o maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector." Basu, [0058]. **Lisogurski** teaches "dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak. Lisogurski, 13:60-67. **Marbach** teaches "The LEDs are preferably pulse-modulated with a pulse frequency on the order of several kHz. Low power, quasi-continuous operation is possible by measuring intermittently, e.g., one measurement lasting 10 seconds every 5 minutes. …depending on the sampling rate and SNR requirements," and performing "measurement algorithms" on "multivariate input data" of measurement signals in order to "better the measurement accuracy a.k.a. SNR." Marbach, 17:1-7, 12:19-27. **LeBoeuf** teaches "Channel A refers to inputs from sensors that collect physiological information plus noise information, and Channel B refers to inputs from sensors that collect primarily … noise information. … The filter 203 properties are updated to minimize the difference between Channel A and the post-processed

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Channel B, denoted as B. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information." LeBoeuf, [0143].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for physiological measurements. These methods and systems provide the benefit of increasing a signal-to-noise ratio of the measure signal. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Smartphone/Tablet References: For example, charted reference **Basu**, as well as numerous other references such as **Kassim**, **Kreger**, **Lisogurski**, **Tran**, all include teachings related to physiological measurement systems. These references provide numerous means for a physiological monitoring system to be configured for use with a smart phone or tablet. For example, **Basu** teaches "health ring 44 which can monitor heart rate on a 24 hour basis," and that "combines the sensor with a…wireless transmitter linked to an application running on the user's cell phone." Basu, [0065]-[0066]. For example, **Kassim** teaches "[t]he optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration," and that "the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is not exhaustive by any means." Kassim, 12:5-14. For example, **Kreger** teaches a "biosensor interface apparatus for use with a mobile communication device 10," that "can be any of a number of mobile phones such as an iPhone® or an Android® phone, a personal digital assistant (PDA)

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such as a Blackberry®, a portable audio playback device such as an MP3 player, a portable media playback device such as an iPod®, or a handheld tablet such as an iPad®." Kreger, 5:40-53; *see also* Kreger, 7:39-46. For example, **Lisogurski** teaches a "monitor [that] may be powered by a battery" with a "[u]ser interface [which] may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device." Lisogurski, 15:19-23, 18:65-67. For example, **Mault** teaches a blood glucose monitoring system including an electronic device that "can be a portable electronic device or system carried by the person, or a device or system combining multiple functionalities, such as:…a portable computer; any portable Internet access device; [or] a wireless phone…." Mault [0069]-[0070]. For example, **Poeze** teaches "a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128," where the "personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc." Poeze, [0034]; *see also* Poeze [0010]. **Tran** teaches that while a patient with a wearable device is outside a mesh network range, "the wearable appliance communicates with the cell phone," such as a "smart phone[]" and "provides information to the server 200 using the cellular connection." Tran, 34:4-30.

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A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide the benefit of more processing power and more convenient means to flag emergency situations. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Cloud References: For example, charted reference **Kassim**, as well as numerous other references such as **Mault, Basu, Lisogurski**, and **Poeze** all include teachings related to physiological measurement systems. These references provide numerous means for a physiological monitoring system to be configured for use a with cloud. For example, **Kassim** teaches that "[t]he computer platform may further be connected to network resources 2006 which connect to the Internet or other components of a local public or private network. The network resources 2006 may provide instructions and data to the computer platform from a remote location on a network 2007." Kassim, 33:34-34:19. **Mault** teaches "[t]he PDA can access the communications network, such as the Internet, using a wireless connection. Data can be transferred to the remote system over the communications network 20." Mault, [0077]. **Basu** teaches "a cloud-based health monitoring and mentoring framework which integrates remote patient monitoring (RPM) with an online community involving medical caregivers and a social network of the patient's peers." Basu, [0081]. **Lisogurski** teaches "monitor 314 and/or multi-parameter physiological monitor 326 may be coupled to a network to enable the sharing of information with servers or other work-stations." Lisogurski, 18:62-65. **Poeze** teaches "the camera is paired with an

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opti cal character recognition module so that scanned medical forms can be converted into data that can be uploaded for synchronization at a server in a network (e.g. a cloud computing network) or stored on the personal health organizer device." Poeze, [0048].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for physiological measurements. These methods improving the analysis capabilities of measurement systems due to the increased processing and storage power of a cloud. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Optical Detection Techniques References: For example, charted reference **Keller**, as well as numerous other references such as **Mault**, **Carlson, Lisogurski, Basu**, **Jung**, and **Marbach** all include teachings related to physiological measurement systems. These references provide numerous means for effective optical detection through various methods, including synchronizing light sources and detectors and modulating the light source. For example, **Keller** teaches that "[t]he light source 102 may also be pulsed or flashed, in order, for example, to synchronize with the imaging devices 305, 504 (see, FIGS. 3 and 5, respectively) of the invention." Keller, [0088]. **Mault** teaches "electrical modulation of a single device may be used to obtain multiple wavelength emission" Mault, [0020]. **Carlson** teaches "us[ing] a light source modulation to temporarily modulate the optical radiation of the LED … in order to shift the power spectrum of the pulsometer signals into a higher frequency range." Carlson, [0063]-[0065]. **Lisogurski** teaches "front end processing circuitry 150 may use the timing control signals to operate

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synchronously with light drive circuitry 120." Lisogurski, 11:41-43. **Basu** teaches "[t]he LED 14 is modulated at 1 KHz frequency or higher. The received PD signal oscillates at the same frequency." Basu, [0037]. **Jung** teaches "[t]he three monochrome sources, however, are turned on and off rapidly, synchronous with the spectral measurements being taken." Jung, 68:26-30. **Lamego** teaches a "digital-to-analog conversion circuit 338" that includes "a synchronizing latch 323" which "accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332." Lamego, [0044]-[0045]. **Marbach** teaches "The LEDs are preferably pulse-modulated with a pulse frequency on the order of several kHz. Low power, quasi-continuous operation is possible by measuring intermittently, e.g., one measurement lasting 10 seconds every 5 minutes." Marbach, 17:1-5.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for physiological measurements. These methods and systems provide increased accuracy for monitoring physiological parameters. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Artificial Intelligence / Multivariate Techniques References: For example, charted reference **Tran**, as well as numerous other references such as **Mault** and **Marbach** all include teachings related to physiological measurement systems. These references provide numerous means for using artificial intelligence and multivariate techniques to make decisions and improve signal-to-noise ratios. For example, **Tran** teaches that "feed forward artificial neural networks (NNs) are used to classify valve-related heart disorders." Tran, 74:45-62. **Mault** teaches that

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"[f]eedback, generated by a specialist or computer expert system, may be transmitted to the PDA from the remote computer over the communications network." Mault, [0077]. **Marbach** teaches performing "measurement algorithms" on "multivariate input data" of measurement signals in order to "better the measurement accuracy a.k.a. SNR." Marbach, 12:19-27.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for physiological measurements. These methods and systems provide increased decision-making capabilities and minimize noise interference. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Arc References: For example, charted reference **Isaacson**, as well as numerous other references such as **Jung**, and **LeBoeuf** all include teachings related to physiological measurement systems. These references provide numerous methods for utilizing a plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. For example, **Isaacson** teaches emitters 10, 20 and detectors 12, 22 disposed on an arc. Isaacson, 4:64-5:9, Fig. 1. For example, **Jung** teaches "a fiber optic arrangement presented at the forward end of probe tip 1" which "utilizes a single central light source fiber optic…and a plurality of perimeter light receiver fiber optics, denoted as light receivers R1, R2 and R3." Jung, 11:21-50, Fig. 2; *see also* Jung 24:39-48, 24:39-62, 32:66-33:9, 39:41-40:14, Figs. 9, 10A-B, 20, 28A-B. For example, **LeBoeuf** teaches optical emitters 24 and optical detectors 26 configured in an arc. LeBoeuf, [0123]-[1024], Fig. 8B

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A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods provide the benefit of better acquisition of signals from the samples. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix D with any other reference or references listed in Appendix D along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the ’304 Patent.

For example, and without limitation, the Asserted Claims of the ’304 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Reflective Surface References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of the Reflective Surface References all of which relate to systems and methods for physiological monitoring. Each of references **LeBoeuf, Basu** and **Valencell** relate to physiological monitoring systems which use a reflective surface to direct the reflected light from a sample to a detector. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the Reflective Surface References provide means—

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not necessarily expressly present in all other references—for using a reflective surface in a sensor to direct the reflected light from a sample to a detector. A POSITA would have understood that the systems and methods for the Reflective Surface References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for incorporating reflective surfaces into sensors to direct the reflected light from a sample to a detector provide improvements such as enhancing the efficiency of the delivery of the light reflected from or transmitted through the tissue to the detectors in the sensor, minimizing loss of light intensity due to scattering. *E.g.*, LeBoeuf, [0125] ("An advantage of this configuration is … this configuration may reduce unwanted optical signals from regions that may not be relevant to the physiological activity of interest.") A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement systems would commonly be combined with reflective surfaces, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of including basic optical components, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with SNR Techniques References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim, Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of the SNR Techniques References all of which relate to systems and methods for physiological monitoring. Each of references **Kassim, Carlson, Basu, Lisogurski, Marbach**, and **LeBoeuf** relate to physiological monitoring systems which use various methods for improving

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signal-to-noise ratio. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the SNR Techniques References provide means—not necessarily expressly present in all other references—for various methods, including increasing light intensity, increasing pulse rate, and differencing detected signals to improve the SNR of a detected signal. A POSITA would have understood that the systems and methods for the SNR Techniques References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for incorporating the usage of various SNR techniques into physiological measurement systems provide improvements such as reducing the effects of background noise or ambient light on the measurement signal and improving the accuracy of the measurement. *E.g.*, Kassim, 22:28-22:30 ("The inventors have recognized that by identifying and utilizing only significant information for Sp02 calculation, an efficient and accurate calculation can be carried out"). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement systems would commonly be combined with SNR improvement techniques, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of using known noise reduction and signal enhancement methods, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Smartphone/Tablet References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any

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one of Smartphone/Tablet References all of which relate to systems and methods for physiological monitoring. Each of references **Basu**, **Kassim**, **Kreger**, **Lisogurski**, **Mault**, **Poeze**, and **Tran** relate to physiological monitoring systems for use with a smartphone or tablet. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Smartphone/Tablet References provide means—not necessarily expressly present in all other references—for a physiological monitoring system to communicate with a smartphone or tablet. A POSITA would have understood that the systems and methods for Smartphone/Tablet References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for connectivity to smartphones or tablets provide improvements improving the analysis capabilities of measurement systems due to the increased processing power of smartphones and tablets and the additional resources provided by their ability to connect to wireless and cell networks. *E.g.*, Basu, [0066] (physiological monitoring system "combines the sensor with a…wireless transmitter linked to an application running on the user's cell phone."); Kreger, 13:1-3 ("Mobile device smart phone 444 may derive measurements, display plots, transmit medical records of biosensor data, and so forth."); Tran, 34:4-40 ("If the wearable appliance detects a cellphone that is mesh network compatible, the wearable appliance communicates with the cell phone," such as a "smart phone" and "provides information to the server 200 using the cellular connection."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical physiological measurement would commonly be combined with smartphone and personal computing technology and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of providing for connectivity to smartphone or personal computing devices in wearable measurement devices that were ready for improvement,

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in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iv) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Cloud References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of the Cloud References all of which relate to systems and methods for physiological monitoring. Each of references **Kassim**, **Mault, Basu, Lisogurski**, and **Poeze** relate to connecting the physiological monitoring system with a cloud. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the Cloud References provide means—not necessarily expressly present in all other references—for a physiological monitoring system to communicate with a cloud. A POSITA would have understood that the systems and methods for the Cloud References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for connectivity to a cloud provide improvements improving the analysis capabilities of measurement systems due to the increased processing and storage power of a cloud and the additional resources provided by their ability to connect to the internet and other remote networks. *E.g.*, Kassim, 34:14-16 ("The network resources may include 15 storage devices for storing data and executable instructions at a location separate from the computer platform 2001"). *E.g.*, Mault, [0077] ("Data can be transferred to the remote system over the communications network 20, allowing examination by a dietician, physician, other specialist"). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical physiological measurement would commonly be combined with cloud connectivity and thus a POSITA would have been

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motivated to combine the teachings of these references. The combination would apply known techniques of providing for connectivity to smartphone or personal computing devices in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(v) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Optical Detection Techniques References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of the Optical Detection Techniques References all of which relate to systems and methods for physiological monitoring. Each of references **Keller, Mault**, **Carlson, Lisogurski, Basu**, **Jung**, and **Marbach** relate to physiological monitoring systems which use various methods for effective optical detection. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the Optical Detection References provide means—not necessarily expressly present in all other references—for various methods, including synchronizing light sources and detectors and modulating the light source for effective optical detection of a sample. A POSITA would have understood that the systems and methods for the Optical Detection References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for incorporating the usage of various optical detection techniques into physiological measurement systems provide improvements such as improving the system's ability to effectively detect and measure samples of interest. *E.g.*, Carlson , [0065] ("AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where

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environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent."); Lamego, [0045] ("[D]river circuit," including "synchronizing latch 323 [that] accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332" "is designed to minimize the noise from the emitters 302."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement systems would commonly be combined with optical detection techniques, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of using known optical detection methods, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(vi) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Artificial Intelligence / Multivariate Techniques References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of the Artificial Intelligence / Multivariate Techniques References all of which relate to systems and methods for physiological monitoring. Each of references **Tran, Mault,** and **Marbach** relate to physiological monitoring systems which use artificial intelligence or multivariate techniques to improve their measurements. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the Artificial Intelligence / Multivariate Techniques References provide means—not necessarily expressly present in all other references—for improving a system's decision-making and the SNR of a measured signal. A POSITA would have understood that the systems and methods for the

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Artificial Intelligence / Multivariate Techniques References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for incorporating the usage artificial intelligence and multivariate techniques into physiological measurement systems provide improvements such as improving the system's ability to effectively make decisions and make accurate measurements with minimal noise interference. *E.g.*, Tran, 5:57-65 ("For example, the system can perform patient behavior analysis such as eating/drinking/smoke habits and medication compliance, among others"). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement systems would commonly be combined with artificial intelligence and multivariate techniques, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of using known artificial intelligence models and multivariate calculation methods, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(vii) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Arc References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of Arc References all of which relate to systems and methods for physiological monitoring. Each of references **Isaacson**, **Jung**, and **LeBoeuf** relate to physiological monitoring systems with their light sources and/or detectors configured in an arc. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Arc References provide means—not necessarily expressly present in all other references—for configuring the

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detectors and/or emitters of a physiological measurement system in an arc formation. A POSITA would have understood that the systems and methods for Arc References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for configuring optical detectors and emitters in an arc formation would provide improvements such as increased measurement accuracy due to lessening the negative effects of light scattering and accounting for the contours of the tissue sample that is being measured. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement would commonly be combined detectors and emitters in an arc formation, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for varying the spatial configurations of emitters and detectors in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits D1 through D19 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-D, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the Lens References, Light Intensity References, Three Wavelength References, Six LED References, Smartphone/Tablet References, Synchronize Light Source/Detector References, and/or Arc References for the reasons discussed above.

5. U.S. Patent No. 11,160,455

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Pursuant to P.R. 3-3(a) and (b), Defendants identify in Appendix E the prior art references that render obvious the Asserted Claims of the ’455 Patent and include below exemplary combinations showing the obviousness of the ’455 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix E, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the ’455 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix E, such reference may be combined with any other references listed in Appendix E for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the ’455 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the ’455 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix E along with the knowledge of one of ordinary skill in the art to meet the limitations of the ’455 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the ’455 Patent obvious when the references are read in combination with each other, and/or when

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read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. Defendants may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix E, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

Reservation of Rights: Moreover, as mentioned above, Defendants have not yet completed their search or discovery concerning additional prior art, including prior art systems that may anticipate and/or render obvious the Asserted Claims (e.g., System Art). As such, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendants reserve the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '455 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. Defendants further believe that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co.*, 869 F.3d 1336, 1344 (Fed. Cir. 2017).

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Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, Defendants identify motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix E would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix E would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '455 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

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Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix E is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix E because all of these references relate to the same area of technology and/or are from analogous art. The ’455 Patent Asserted Claims are directed to a physiological measurement system. ’455 Patent at Abstract. The ’455 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the ’455 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the

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teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the ’455 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to wearable devices measuring physiological parameters.

Demand and Market Forces: For example, market forces suggested a demand for wearable devices for measuring physiological parameters, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the ’455 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the ’455 Patent, there are a finite number of approaches for providing a wearable device for measuring physiological parameters. For example, as of the priority date of the ’455 Patent, a POSITA would have been very familiar with basic elements of the ’455 Patent’s claims such as semiconductors, optical wavelengths, lenses, signal-to-noise ratio, detectors, analog to digital converters, smart phones/tablets, cloud, and their configurations and/or means for the same. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the ’455 Patent’s claims does not render them novel or non-obvious.

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There are significant similarities in subject matter and objectives for each of many references used in these contentions for the ’455 Patent.

Lens References: For example, charted reference **Carlson**, as well as numerous other references such as **LeBoeuf**, **Poeze**, **Pologe**, and **Valencell** all include teachings related to physiological measurement systems. These references provide numerous means and methods for using lenses to receive at least a portion of the output optical light and to deliver a lens output light to tissue, which were already well known in the art. For example, **Carlson** teaches using “a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light Source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise-and signal/Background ratio.” Carlson, [0014]; *see also* Carlson, [0024]; [0041], [0062], FIG. 6c. Fore example, **LeBoeuf** teaches “lenses 29L [] configured to focus inspection light 111 onto a particular region of the ear.” LeBoeuf, [0114]; *see also* LeBoeuf, [0011], [0019], [0031], [0036], [0097], [0114], [0116] [0117], [0135], [0138], [0161], [0168]. For example, **Poeze** teaches “the device 112 includes an optional tissue thickness adjuster or tissue shaper 522, which can include one or more…lenses….” Poeze, [0102]. **Pologe** further teaches a “wavelength division multiplexing (WDM) coupler[]” using a lens to combine light signals from emitters into a “single multiplexed light signal on output cable 24.” Pologe, 5:16-51. For example, **Valencell** teaches “optical lenses 715 [that] may be designed for the desired optical coupling between the skin/blood vessel region and the emitter 102 or detector 103.” Valencell, [0118]; *see also* Valencell, [0016]-[0017], [0022]-[0023], [0038], [0119], [0121], [0124]-[0125], [0128]-[0131].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These

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methods provide the benefit of increasing the light intensity to increase signal-to-noise ratio, without increasing power usage. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Light Intensity References: For example, charted reference **Basu**, as well as numerous other references such as **Kassim**, **Lisogurski**, and **Valencell** all include teachings related physiological measurement systems. These references provide numerous methods for increasing the signal-to-noise ratio by increasing light intensity of at least one of the semiconductor sources from an initial light intensity. For example, **Basu** teaches "[t]o maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector." Basu, [0058]. For example, **Kassim** teaches "the effects of ambient light signals 30 can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation." Kassim, 16:27-35. For example, **Lisogurski** discloses the "system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio." Lisogurski, 9:46-60. For example, **Valencell** teaches "the intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight." Valencell, [0123].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide the benefit of increasing a signal-to-noise ratio of the measure signal.

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Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Three Wavelength References: For example, charted reference **Basu**, as well as numerous other references such as **Lisogurski**, **Lamego**, **LeBoeuf**, **Poeze**, and **Valencell** all include teachings related to physiological measurement systems. These references provide numerous methods for using three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters and using one of said wavelengths to improve measurement of at least one of the one or more physiological parameters using the output signal corresponding to the other two optical wavelengths. For example, **Lisogurski** discloses that its light source "emit photonic signals having one or more wavelength of light" and "include any number of light sources with any suitable characteristics." Lisogurski, 10:48-60, 10:65-11:6, 17:17-39. For example, **Basu** teaches "three LEDs 14, 14′, and 15 may all emit different wavelengths. LEDs 15, and 14, for example, may emit light in the red and IR spectrum, respectively, while LED 14′ may emit light at a wavelength at which the presence of falsifying components can be detected." Basu, [0109]. For example, **Lamego** teaches a multiwavelength physiological monitor "utiliz[ing] at least three different wavelengths of light . . . to determine blood oxygen saturation," and that "adding wave lengths sensitive to additional significant absorbers can help the system compensate for the additional significant absorbers and enable more accurate calculation of the concentration of each absorber and the blood oxygen saturation." Lamego, [0033], [0035]; *see also* Lamego [0034], [0036]-[0037], [0041]. For example, **LeBoeuf** teaches"[t]he optical detectors 26 and emitters 24 may be of multiple wavelengths, with the goal

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of providing specialized physiological information for each wavelength. Referring to FIG. 19, for example, violet or UV light may be used to measure motion-related aspects of the ear, as violet and UV light may not penetrate greatly through the skin of the ear. Green, red, and IR wavelengths may have deeper penetration and provide information on the blood vessels and blood analyte levels. Blue wavelengths may be particularly useful for gauging changes in the size of the blood vessels." LeBoeuf, [0153]; *see also* LeBouef, [0163]. For example, **Poeze** teaches "the emitter 504 of the data collection device 112 can emit, in certain embodiments, combinations of optical radiation in various bands of interest. For example, in some embodiments, for analytes like glucose, the emitter 504 can emit optical radiation at three (3) or more wavelengths between about 1600 nm to about 1700 nm. In particular, the emitter 504 can emit optical radiation at or about 1610 nm, about 1640 nm, and about 1665 nm. In some circumstances, the use of three wavelengths within about 1600 nm to about 1700 nm enable sufficient SNRs of about 100 dB, which can result in a measurement accuracy of about 20 mg/dL or better for analytes like glucose." Poeze, [0109]; *see also* Poeze, [0108], [0110]-[0116]. For example, **Valencell** teaches "collecting light at different wavelengths, and processing these signals collectively, can be used to generate assessments of blood gas levels, such as blood oxygen (SpO2) and carbon dioxide (SpCO2), blood hemoglobin types and levels, or other blood constituents and their respective concentration levels. Multiple wavelengths may be generated by a signal multiwavelength optical emitter, multiple optical emitters, optically filtered optical emitters, or the like. In such case, multiple optical emitters 102 may be located between the two optical filters 715." Valencell, [0130].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide the benefit of increased accuracy in measuring physiological

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parameters. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Six LED References: For example, charted reference **Lamego**, as well as numerous other references such as **LeBoeuf**, **Lisogurski**, and **Pologe** all include teachings related to physiological measurement systems. These references provide numerous means for utilizing a plurality of semiconductor sources comprising six light emitting diodes. For example, **Lamego** teaches a multiwavelength physiological monitor "includ[ing] . . . six . . . LEDs of different wavelengths," and that "adding wave lengths sensitive to additional significant absorbers can help the system compensate for the additional significant absorbers and enable more accurate calculation of the concentration of each absorber and the blood oxygen saturation." Lamego, [0041], [0035]; *see also* Lamego [0033]-[0034], [0036]-[0037]. For example, **LeBoeuf** teaches utilizing "multiple light emitters… of different wavelengths." LeBoeuf, [0163]. For example, **Lisogurski** teaches "that light source 130 may include any number of light sources with any suitable characteristics," and that light source 130 ma include LEDs. Lisogurski, 10:42-11:8. For example, **Pologe** teaches a "main test unit 12 includes: an emitter module 18 having a plurality of emitters 20," and that the "emitters 20 may include…light emitting diodes (LEDs)." Pologe, 4:63-65, 5:16-20.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide the benefit of increased accuracy in measuring physiological parameters. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been

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motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Smartphone/Tablet References: For example, charted reference **Basu**, as well as numerous other references such as **Kassim**, **Kreger**, **Lisogurski**, **Tran**, all include teachings related to physiological measurement systems. These references provide numerous means for a physiological monitoring system to be configured for use with a smart phone or tablet. For example, **Basu** teaches "health ring 44 which can monitor heart rate on a 24 hour basis," and that "combines the sensor with a…wireless transmitter linked to an application running on the user's cell phone." Basu, [0065]-[0066]. For example, **Kassim** teaches "[t]he optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration," and that "the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is not exhaustive by any means." Kassim, 12:5-14. For example, **Kreger** teaches a "biosensor interface apparatus for use with a mobile communication device 10," that "can be any of a number of mobile phones such as an iPhone® or an Android® phone, a personal digital assistant (PDA) such as a Blackberry®, a portable audio playback device such as an MP3 player, a portable media playback device such as an iPod®, or a handheld tablet such as an iPad®." Kreger, 5:40-53; *see also* Kreger, 7:39-46. For example, **Lisogurski** teaches a "monitor [that] may be powered by a battery" with a "[u]ser interface [which] may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device." Lisogurski, 15:19-23, 18:65-67. For example, **Mault** teaches a blood glucose monitoring

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system including an electronic device that "can be a portable electronic device or system carried by the person, or a device or system combining multiple functionalities, such as:…a portable computer; any portable Internet access device; [or] a wireless phone…." Mault [0069]-[0070]. For example, **Poeze** teaches "a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128," where the "personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc." Poeze, [0034]; *see also* Poeze [0010]. **Tran** teaches that while a patient with a wearable device is outside a mesh network range, "the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection." Tran, 34:4-30.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide the benefit of more processing power and more convenient means to flag emergency situations. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other

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references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Synchronize Light Source/Detector References: For example, charted reference **Carlson**, as well as numerous other references such as **Jung**, **Lamego**, **Lisogurski**, and **Poeze** all include teachings related to physiological measurement systems. These references provide numerous methods for utilizing a detection system that is configured to be synchronized to the light source. For example, **Carlson** teaches using "AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent." Carlson, [0064]-[0065]; *see also* Carlson, [0011]-[0020], [0018]-[0020], [0027]. For example, **Jung** discloses a spectrometer system were "three monochrome sources, however, are turned on and off rapidly, synchronous with the spectral measurements being taken at, for example, a rate of 1000 Hz." Jung, 68:13-33. For example, **Lamego** teaches a "digital-to-analog conversion circuit 338" that includes "a synchronizing latch 323" which "accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332." Lamego, [0044]-[0045]; *see also* Lamego [0050]-[0051], [0069]. For example, **Lisogurski** teaches "light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120." Lisogurski, 11:41-12:9; *see also* Lisogurski, 12:52-13:6 9 ("The peaks of detector current waveform 214 may be synchronous with light 'on' periods driving one or more emitters of a light source, such as light

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Source 130 of FIG. 1."). For example, **Poeze** teaches a "data collection device 112" including "a driver 520 that drives the emitter 504," wherein "[t]he driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504." Poeze, [0116]-[0117].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide increased accuracy for monitoring physiological parameters. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Arc References: For example, charted reference **Isaacson**, as well as numerous other references such as **Jung**, and **LeBoeuf** all include teachings related to physiological measurement systems. These references provide numerous methods for utilizing a plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. For example, **Isaacson** teaches emitters 10, 20 and detectors 12, 22 disposed on an arc. Isaacson, 4:64-5:9, Fig. 1. For example, **Jung** teaches "a fiber optic arrangement presented at the forward end of probe tip 1" which "utilizes a single central light source fiber optic…and a plurality of perimeter light receiver fiber optics, denoted as light receivers R1, R2 and R3." Jung, 11:21-50, Fig. 2; *see also* Jung 24:39-48, 24:39-62, 32:66-33:9, 39:41-40:14, Figs. 9, 10A-B, 20, 28A-B. For example, **LeBoeuf** teaches optical emitters 24 and optical detectors 26 configured in an arc. LeBoeuf, [0123]-[1024], Fig. 8B

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A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods provide the benefit of better acquisition of signals from the samples. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix E with any other reference or references listed in Appendix E along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the ’455 Patent.

For example, and without limitation, the Asserted Claims of the ’455 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Lens References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Lens References all of which relate to systems and methods for physiological monitoring. Each of references **Carlson**, **LeBoeuf**, **Poeze**, **Pologe**, and **Valencell** relate to physiological monitoring systems utilizing lenses. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Lens References provide means—not necessarily expressly present in all other references—for a wearable device comprising one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens

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output light to tissue. A POSITA would have understood that the systems and methods for Lens References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for wearable device comprising one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue provide improvements such as focusing output optical light to increase the intensity of the light transmitted to the wearer's tissue thereby reducing the light source's power consumption, reducing the detrimental effects of ambient light, reducing the loss of energy due to scattered light, and increasing signal-to-noise ratio. *E.g.*, Carlson, [0014] (lens system "increase[s] the optical signal power, detected by the pulsoximeter sensor, and thus increase[s] the Signal/Noise-and signal/Background ratio."); LeBoeuf, [0114] ("Lenses 29L are configured to focus inspection light 111 onto a particular region of the ear."). Valencell, [0017] ("The first lens focuses light emitted by the optical emitter…."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement systems would commonly be combined with lens systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of including basic optical components, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Light Intensity References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Light Intensity References all of which relate to systems and methods for physiological

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monitoring. Each of references **Basu, Kassim**, **Lisogurski**, and **Valencell** relate to physiological monitoring systems that utilize increased light intensity of their emitters to increase signal-to-noise ratio of their detection signal. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Light Intensity References provide means—not necessarily expressly present in all other references—for improving signal-to-noise ratio by increasing the intensity of light sources. A POSITA would have understood that the systems and methods for Light Intensity References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for improving signal-to-noise ratio by increasing the intensity of light sources provide improvements such as increasing the accuracy of measured physiological parameters. *E.g.*, Basu, [0058] ("To maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector."); Kassim, 16:27-35 ("[T]he effects of ambient light signals 30 can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation."), Lisogurski 9:46-60 ("[S]ystem may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio."); Valencell, [0123] ("[T]he intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurements systems would commonly be combined with circuity coupled to light sources that allow for the control of the light source's parameters, such as light intensity, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of allowing for the variability of light source parameters to wearable measurement devices that were

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ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Three Wavelength References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Three Wavelength References all of which relate to systems and methods for physiological monitoring. Each of references **Basu**, **Lamego**, **LeBoeuf**, **Poeze**, and **Valencell** relate to physiological monitoring systems utilizing three wavelengths and using one of said wavelengths to improve measurement of at least one of the one or more physiological parameters using the output signal corresponding to the other two optical wavelengths. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Three Wavelength References provide means—not necessarily expressly present in all other references—for using three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters or using one of said wavelengths to improve measurement of at least one of the one or more physiological parameters using the output signal corresponding to the other two optical wavelengths. A POSITA would have understood that the systems and methods for Three Wavelength References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for utilizing three optical wavelengths provide improvements such as the ability to target different physiological absorbers according to their wavelength sensitivity and therefore providing for more accurate measurements. *E.g.*, Basu, [0109] ("It is known that certain factors may render pulse oximetry unreliable because the presence of other components (e.g. methemoglobin or carboxyhemoglobin) in the blood may

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mimic the absorption of oxyhemoglobin at the IR LED frequency so that the reading is falsified. Such errors can be minimized by adding a third LED emitting light of a wavelength at which the component shows a different behavior than oxyhemoglobin and reduced hemoglobin."); Lamego, [0035] ("[A]dding wave lengths sensitive to additional significant absorbers can help the system compensate for the additional significant absorbers and enable more accurate calculation of the concentration of each absorber and the blood oxygen saturation."); Poeze, [0109] ("[T]he use of three wavelengths within about 1600 nm to about 1700 nm enable sufficient SNRs of about 100 dB, which can result in a measurement accuracy of about 20 mg/dL or better for analytes like glucose."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for multiwavelength emitters would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of the variability of light source parameters, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iv) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Six LED References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Six LED References all of which relate to systems and methods for physiological monitoring. Each of references **Lamego**, **LeBoeuf**, **Lisogurski**, and **Pologe** relate to physiological monitoring systems using multiple LEDs as emitters. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Six LED References

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provide means—not necessarily expressly present in all other references—for utilizing six LED optical emitters in a light source. A POSITA would have understood that the systems and methods for Six LED References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for utilizing six LEDs provide improvements such as the ability to target different physiological absorbers according to their wavelength sensitivity and therefore providing for more accurate measurements, increasing intensity of optical output light, and reducing the detrimental effects on ambient light. *E.g.*, Lamego, [0035] ("[A]dding wave lengths sensitive to additional significant absorbers can help the system compensate for the additional significant absorbers and enable more accurate calculation of the concentration of each absorber and the blood oxygen saturation."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical physiological measurement would commonly be combined with multiple LED emitters and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for increasing the number of optical emitters in a light to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(v) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Smartphone/Tablet References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Smartphone/Tablet References all of which relate to systems and methods for physiological monitoring. Each of references **Basu**, **Kassim**, **Kreger**, **Lisogurski**, **Mault**, **Poeze**, and **Tran**

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relate to physiological monitoring systems for use with a smartphone or tablet. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Smartphone/Tablet References provide means—not necessarily expressly present in all other references—for a physiological monitoring system to communicate with a smartphone or tablet. A POSITA would have understood that the systems and methods for Smartphone/Tablet References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for connectivity to smartphones or tablets provide improvements improving the analysis capabilities of measurement systems due to the increased processing power of smartphones and tablets and the additional resources provided by their ability to connect to wireless and cell networks. *E.g.*, Basu, [0066] (physiological monitoring system "combines the sensor with a…wireless transmitter linked to an application running on the user's cell phone."); Kreger, 13:1-3 ("Mobile device smart phone 444 may derive measurements, display plots, transmit medical records of biosensor data, and so forth."); Tran, 34:4-40 ("If the wearable appliance detects a cellphone that is mesh network compatible, the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical physiological measurement would commonly be combined with smartphone and personal computing technology and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of providing for connectivity to smartphone or personal computing devices in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve

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simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

References Lisogurski and Basu Combined with Synchronize Light Source/Detector References

A POSITA would have had reason to combine references **Lisogurski** or **Basu**, or any of the references in Appendix E, with any one of Synchronize Light Source/Detector References all of which relate to systems and methods for physiological monitoring. Each of references **Carlson**, **Jung**, **Lamego**, **Lisogurski**, and **Poeze** relate to physiological monitoring systems that synchronize their detection systems to the their light sources. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Synchronize Light Source/Detector References provide means—not necessarily expressly present in all other references—for synchronizing the sampling of a detector to the output of a light source. A POSITA would have understood that the systems and methods for Synchronize Light Source/Detector References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for synchronizing the sampling of a detector to the output of a light source provide improvements such as increased measurement accuracy. *E.g.*, Carlson, [0065] ("AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent."); Lamego, [0045] ("[D]river circuit," including "synchronizing latch 323 [that] accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332" "is designed to minimize the noise from the emitters 302."); Poeze, [0117] ("The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of

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optical radiation emitted from the emitter 504."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement would commonly be combined with detector and light source synchronization, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for varying the collection parameters of a detection system and the output parameters of light source in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(vi) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Arc References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Arc References all of which relate to systems and methods for physiological monitoring. Each of references **Isaacson**, **Jung**, and **LeBoeuf** relate to physiological monitoring systems with their light sources and/or detectors configured in an arc. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Arc References provide means—not necessarily expressly present in all other references—for configuring the detectors and/or emitters of a physiological measurement system in an arc formation. A POSITA would have understood that the systems and methods for Arc References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for configuring optical detectors and emitters in an arc formation would provide improvements such as increased measurement accuracy due to lessening the negative effects of light scattering and accounting for the contours of the tissue sample that is being measured. A

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POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement would commonly be combined detectors and emitters in an arc formation, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for varying the spatial configurations of emitters and detectors in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits E1 through E18 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-E, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the Lens References, Light Intensity References, Three Wavelength References, Six LED References, Smartphone/Tablet References, Synchronize Light Source/Detector References, and/or Arc References for the reasons discussed above.

6. U.S. Patent No. 12,193,790

Pursuant to P.R. 3-3(a) and (b), Defendants identify in Appendix F the prior art references that render obvious the Asserted Claims of the '790 Patent and include below exemplary combinations showing the obviousness of the '790 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix F, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the '790 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any

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one of the anticipatory references described in Appendix F, such reference may be combined with any other references listed in Appendix F for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the '790 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '790 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix F along with the knowledge of one of ordinary skill in the art to meet the limitations of the '790 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the '790 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. Defendants may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix F, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

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Reservation of Rights: Moreover, as mentioned above, Defendants have not yet completed their search or discovery concerning additional prior art. As such, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendants reserve the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '790 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. Defendants further believe that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co.*, 869 F.3d 1336, 1344 (Fed. Cir. 2017). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, Defendants identify motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix F would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same

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way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix F would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '790 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix F is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8)

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the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix F because all of these references relate to the same area of technology and/or are from analogous art. The '790 Patent Asserted Claims are directed to "An optical system comprises a wearable device for measuring one or more physiological parameters." '790 Patent at Abstract. The '790 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the '790 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the '790 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to wearable devices measuring physiological parameters.

Demand and Market Forces: For example, market forces suggested a demand for

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wearable devices measuring physiological parameters, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the '790 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the '790 Patent, there are a finite number of approaches for providing a wearable device for measuring physiological parameters. For example, as of the priority date of the '790 Patent, a POSITA would have been very familiar with basic elements of the '790 Patent's claims such as semiconductors diodes, optical wavelengths, lenses, signal-to-noise ratio, detectors, and analog to digital convertors. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the '790 Patent's claims does not render them novel or non-obvious.

There are significant similarities in subject matter and objectives for each of many references used in these contentions for the '790 Patent.

References disclosing lenses: For example, charted reference Carlson, Poeze, and Soller, as well as numerous other references such as LeBoeuf and Park, all include teachings related to using one or more lenses configured to receive a portion of at least one of the output optical lights and to direct a lens output light to tissue. These references provide numerous methods for using lenses to direct an optical output beam. For example, Carlson teaches "us[ing] a beam-shaping

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element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise—and signal/Background ratio. The increase of the S/B ratio is estimated e.g. to a factor 5." Carlson at [0014]. Poeze teaches "[using] a lens which collects attenuated light exiting the measurement site and focuses onto one or more detectors. The protrusion can advantageously include plastic, including a hard opaque plastic, such as a black or other colored plastic, helpful in reducing light noise." Poeze at 7:52-8:7. Soller teaches "a variety of different collimating elements 56 can be used in sensor 10. Exemplary collimating elements include fiber faceplates (e.g., fiber optic windows), collimating hole devices, gradient index (GRIN) lenses, fiber bundles, lens arrays, optical windows (including shaped optical windows), and other similar devices." Soller at 18:37-56.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with using lenses to direct an optical output beam. These methods are known to be effective in directing an optical output beam using known lens structures. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of directing an optical output beam.

References disclosing techniques for increasing signal-to-noise ratio: For example, charted reference Basu, Lisogurski, and Carlson, as well as numerous other references such as LeBoeuf and Park, all include teachings related to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. These

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references provide numerous methods for increasing a light intensity and increasing a pulse rate of an LED. For example, Basu teaches that "[t]o maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector. In the OPS 10, the LED intensity and modulation frequencies are programmable through the serial interface. In the case of the Vishay VCNL4000, the intensity is programmable from 10-200 mA in 10 mA increments." Basu at [0058]. Lisogurski teaches "that modulation of the light drive signal . . . may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof" and that "[t]he system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio." Lisogurski at 27:44-55, 9:46-60. Carlson teaches that the "frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio." Carlson at [0069]. LeBoeuf teaches that "the intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight" and that "it is important to consider the emitter pulsing frequency and sampling approach" because "choosing a frequency that is too low may result in unsatisfactory subtraction." LeBoeuf at [0123], [0139]. Park teaches that "the light source intensity may be increased to maintain the output signal from the light detector within a desired range of output values." Park at 16:8-20.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with improving signal-to-noise

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ratio in optical measurement systems. These methods are known to be effective in improving the signal-to-noise ratio for such systems, and merely modulate the functioning of the existing LEDs in each system. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of improving signal-to-noise ratio.

References disclosing an analog to digital converter: For example, charted reference Basu, Goodman, Lisogurski, Rulkov, Moon, Poeze, Chandrasekar, Al-Ali, Kreger, and Sakai all include teachings related to an analog to digital converter. These references provide numerous methods for using an analog to digital converter coupled to a detector. For example, Basu discloses "a digital interface for communication with a microcontroller." Basu at [0007]. Goodman discloses "On board analog-to-digital converter A/D 44 (10 bit, 5 channel input) is used to convert the conditioned PPG signals at B and B′ into time sampled digital signals which are then provided to processing device 14. Goodman at 11:66-12:21. Lisogurski discloses a "[f]ront end processing circuitry 150 may perform various analog and digital processing of the detector signal." Lisogurski at 12:42-51. Rulkov discloses that "The microprocessor741 has a LED control715 connected to DAC702 for controlling the intensity of the LEDs737. The signal from the photodetector736 is transmitted to a high pass filter (HPF) 703 which sends it to an analog to digital converter704, and the signal from the photodetector737 is also sent directly to a second analog to digital converter704." Rulkov at 11:39-60. Moon discloses that "[a] filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG." Moon at [0091]. Poeze discloses "[f]ront-end

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interfaces 108 may be implemented using transimpedance amplifiers that are coupled to analog to digital converters in a sigma delta converter." Poeze at 40:15-27. Chandrasekar discloses "In principle, PPGs are considered simple devices; however, in practice, implementation requires a careful design involving optics (multiple paths, alignments, leakage barriers) and mixed signal electronics (transimpedance amplifiers, analog digital conversion, drivers, modulators, filters)." Chandrasekar at 1. Kreger discloses "Biosensor signals may also be received by one or more RF receivers in the dock 246 (not shown) and communicated to the mobile 212 via wired electrical connector 246, for example, to allow the wireless sensor to utilize the features of the wired audio input's anti-alias filters and analog to digital converter as will be explained in detail below." Kreger at 10:14-28. Sakai discloses "A/D converter 2013 d which converts a voltage value of analog signal into 10-bit digital value." Al-Ali discloses "As shown in FIG. 2, the processor board 250 includes a front end signal conditioner 252, an analog-to-digital (A/D) converter 253, a digital signal processor (DSP) 258, a memory reader 256, emitter drivers 254 and digital-to-analog (D/A) converters 255." Al-Ai at [0045].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with incorporating an analog to digital converter into optical measurement systems. These methods are known to be effective in incorporating an analog to digital converter into such systems. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of signal processing.

References disclosing spatially separated detectors: For example, charted references

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Lisogurski, Poeze, Soller, and Terumoto, all include teachings related to using detectors that are spatially separated. These references provide numerous methods for using light detectors. For example, Lisogurski teaches that "[o]ne or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart." Lisogurski at 17:35-45. Poeze discloses that "multiple detectors are employed and arranged in a spatial geometry. This spatial geometry provides a diversity of path lengths among at least some of the detectors and allows for multiple bulk and pulsatile measurements that are robust." Poeze at 9:18-27. Soller discloses "a plurality of spectral detectors attached to the circuit board, each spectral detector being configured to analyze radiation derived from the radiation source" and depicts the detectors as spatially separated. Soller at 3:16-27; Fig. 34. Terumoto discloses "[t]he light sensor portions 101-1 to 101-n are located equally spaced from one another and to go round the armlet type housing 107 same as the fourth to sixth implementations." Terumoto at [0152].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that detect light. These methods provide using detectors that are spatially separated. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological parameters.

References disclosing detection system is synchronized to the light source: For example, charted reference Lisogurski, Carlson, Poeze, Kreger, and Sakai all include teachings

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related to detection system is synchronized to the light source. These references provide numerous methods for synchronizing detection system with the light source. For example, Lisogurski discloses "he front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals." Lisogurski at 11:33-49. Carlson discloses "[t]he basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3." Carlson at [0065]. Poeze teaches that "[a] control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 104. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 104 to follow a precise timing and consistent pattern." Poeze at 15:27-48. Kreger discloses "Thus, it is another object to provide compatible signals to the mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise and drift, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth." Kreger at 3:17-23. Sakai discloses "he A/D converter 14 operates in synchronization with the light emission timing of the driver 12, to thereby convert the pulse wave detection signal detected upon light emission from the green LED 11 a and the body motion detection signal detected upon light emission from the infrared LED 11 b into digital data, and provides these digital data, as biological

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information, to the information processor 20." Sakai at 5:66-6:9.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with measuring physiological parameters. These methods are known to be effective in incorporating synchronizing detection system with the light source. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of signal processing.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix C with any other reference or references listed in Appendix C along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the '790 Patent.

For example, and without limitation, the Asserted Claims of the '790 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) Rulkov, Basu, Goodman, Chandersekar, Kassim, Lisogurski, Moon, Terumoto, Al-Ali, Kreger, and Sakai combined with References disclosing lenses

A POSITA would have had reason to combine references Rulkov, Basu, Goodman, Kassim, Lisogurski, Moon, Terumoto, Al-Ali, Kreger, and Sakai with any one of References disclosing lenses, all of which relate to systems and methods for using lenses to direct an optical output beam. Each of References disclosing lenses relate to using one or more lenses configured to receive a portion of at least one of the output optical lights and to direct a lens output light to tissue. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing lenses provide means—not necessarily

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expressly present in all other references—for using lenses to direct an optical output beam. A POSITA would have understood that the systems and methods for References disclosing lenses were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using lenses provide improvements such as disrecting the light to tissue. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using lenses to direct an optical output beam would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using lenses to direct an optical output beam, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Kassim, Rulkov, Goodman, Moon, Chandersekar, Poeze, Soller, Terumoto, Al-Ali, Kreger, and Sakai combined with References disclosing techniques for increasing signal-to-noise ratio

A POSITA would have had reason to combine Kassim, Rulkov, Goodman, Moon, Poeze, Soller, Terumoto, Al-Ali, Kreger, and Sakai with any one of References disclosing techniques for increasing signal-to-noise ratio, all of which relate to systems and methods for increasing a light intensity and increasing a pulse rate of an LED. Each of References disclosing techniques for increasing signal-to-noise ratio relate to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing techniques for increasing signal-to-noise ratio

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provide means—not necessarily expressly present in all other references—for increasing signal-to-noise ratio relate to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. A POSITA would have understood that the systems and methods for References disclosing techniques for increasing signal-to-noise ratio were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for increasing a light intensity and increasing a pulse rate of an LED provide improvements such as increasing signal-to-noise ratio. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for increasing signal-to-noise ratio would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for increasing signal-to-noise ratio, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) Carlson, Kassim, Soller, Chandersekar, and Terumoto combined with References disclosing an analog to digital converter

A POSITA would have had reason to combine references Carlson, Kassim, Soller, and Terumoto with any one of References disclosing an analog to digital converter, all of which relate to systems and methods for using an analog to digital converter coupled to a detector. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing an analog to digital converter provide means—not necessarily expressly present in all other references—for using an analog to digital converter coupled to a detector. A POSITA would have understood that the systems and methods for

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References disclosing an analog to digital converter were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using an analog to digital converter provide improvements such as ability to process a signal digitally. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using an analog to digital converter would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using an analog to digital converter, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iv) Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Al-Ali, Kreger, and Sakai combined with References disclosing spatially separated detectors

A POSITA would have had reason to combine references Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Al-Ali, Kreger, and Sakai with any one of References disclosing spatially separated detectors all of which relate to systems and methods for using spatially separated detectors. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing spatially separated detectors provide means—not necessarily expressly present in all other references—for using spatially separated detectors. A POSITA would have understood that the systems and methods for References disclosing spatially separated detectors were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for spatially separated detectors provide improvements such as improved detection quality. A POSITA would further understand that in order to implement a wearable measurement device, the systems and

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methods for measuring physiological parameters would commonly be combined with spatially separated detectors, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using spatially separated detectors, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(v) Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Soller, Terumoto, and Al-Ali combined with References disclosing detection system is synchronized to the light source

A POSITA would have had reason to combine references Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Soller, Terumoto, and Al-Ali with any one of References disclosing detection system is synchronized to the light source, all of which relate to systems and methods for synchronizing a detection system with a light source. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing detection system is synchronized to the light source provide means—not necessarily expressly present in all other references—for synchronizing a detection system with a light source. A POSITA would have understood that the systems and methods for References disclosing detection system is synchronized to the light source were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for synchronizing a detection system with a light source provide improvements such as improved detection. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with techniques for synchronizing a detection system with a light

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source, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for synchronizing a detection system with a light source, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits F1 through F14 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-F, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the References disclosing lenses, References disclosing techniques for increasing signal-to-noise ratio, References disclosing an analog to digital converter, References disclosing spatially separated detectors, References disclosing detection system is synchronized to the light source, for the reasons discussed above.

V. P.R. 3-3(c) – Claim Charts

Pursuant to Rule 3-3(c), Defendants identify invalidity claim charts identifying disclosures in the references identified in Sections III-IV supra as to the Asserted Claims of the Asserted Patents are provided in attached Appendix A ('868 Patent), Appendix B ('533 Patent), Appendix C ('484 Patent), Appendix D ('304 Patent), Appendix E ('455 Patent), and Appendix F ('790 Patent).

Defendants have identified relevant portions and/or features of the prior art. However, the identified prior art may contain additional descriptions of or alternative support for the claim

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limitations. Defendants may rely on uncited portions or features of the identified prior art, other documents, and expert testimony, to provide context or to aid in understanding the identified prior art and the state of the art. Citations to a particular figure in a reference include the caption and description of the figure and any text relating to the figure. Similarly, citations to particular text referring to a figure include the figure and caption as well. Portions relevant to dependent claims incorporate by reference the citations to the chain of claims from which that dependent claim derives. Likewise, portions related to subsequent limitations that refer to claim elements identified, described, and/or cited to in earlier limitations may rely on the citations related to those portions of the claim chart that identify and/or describe these elements.

Throughout the invalidity claim charts in Appendices A-F, Defendants provide exemplary citations showing where references disclose subject matter recited in preambles of the Asserted Claims, regardless of whether the preambles limit the claims. Defendants reserve the right to argue that the preambles are or are not limitations. Further, where an entry in a claim chart corresponding to a given limitation refers back to the discussion of another claim, the entry incorporates all evidence cited for the other claim.

As noted above, the asserted claims have not yet been construed. Additional portions of the references may become relevant after claim construction. Further, to the extent that any claim term is governed by 35 U.S.C. § 112 ¶ 6, the claim charts identify, by the citations provided, the structure(s), act(s), or material(s) in each reference performing the claimed function for each limitation of the asserted claims. Plaintiffs' claim construction positions, expert analysis and testimony, and additional discovery could all inform which portions of the references disclose a limitation, including under 35 U.S.C. § 112 ¶ 6, and whether any particular limitation is governed by 35 U.S.C. § 112 ¶ 6. Defendants' contentions are based on the information presently available,

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and Defendants reserve all rights to provide their claim construction positions in accordance with the Docket Control Order in this case.

VI. P. R. 3-3(d) – Other Grounds for Invalidity

A. U.S. Patent No. 9,055,868

Pursuant to Rule 3-3(d), Defendants hereby identify grounds of invalidity for the '868 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. Defendants' invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '868 Patent Asserted Claims. Consequently, Defendants only identify the issues under 35 U.S.C. § 112 of which they are presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '868 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '868 Patent Asserted Claims at the time the '868 Patent was filed, at least as plaintiff appears to be asserting those limitations. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to

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those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '868 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '868 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '868 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '868 Patent fail to sufficiently enable the limtiations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '868 Patent fails to sufficiently describe or enable them as required by 35 U.S.C. § 112, ¶ 1:[9]

Term	Relevant Claim(s)
"a software application capable of generating data"	7
"a status of the user"	7
"at least a portion of the status or associated information"	7
"a multiplexer capable of combining the plurality of semiconductor diodes"	8

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted).

[9] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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"Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '868 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '868 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '868 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 901 (2014). Several of the '868 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '868 Patent Asserted Claims are indefinite in whole, in part or in combination:[10]

Term	Relevant Claim(s)
"a part of a user's body comprising blood"	7
"physiological information associated with the user"	7
"wireless data"	7
"voice input signals and manually entered input signals"	7
"at least a portion of the status or associated information"	7

[10] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
"a multiplexer capable of combining the plurality of semiconductor diodes"	8
"generating the input light beam comprising one or more wavelengths"	8
"adapted for use in a diagnostics"	9
"a plurality of associated wavelengths transmitted or reflected from the blood"	9

B. U.S. Patent No. 9,651,533

Pursuant to Rule 3-3(d), Defendants hereby identify grounds of invalidity for the '533 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. Defendants' invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '533 Patent Asserted Claims. Consequently, Defendants only identify the issues under 35 U.S.C. § 112 of which they are presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '533 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '533 Patent Asserted Claims at the time the '533 Patent was filed, at least as plaintiff appears to be asserting those limitations.

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Ariad Pharms., Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '533 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '533 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '533 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '533 Patent fail to sufficiently enable the limtiations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '533 Patent fails to sufficiently describe or enable them as required by 35 U.S.C. § 112, ¶ 1:[11]

Term	Relevant Claim(s)
"the light emitting diodes configured to generate an output optical beam with one or more optical wavelengths"	5
"the processed output signal"	5
"one of more detectors"	11
"to select a fraction of the one or more optical wavelengths"	11

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus.,*

[11] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Inc., 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '533 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '533 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '533 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 901 (2014). Several of the '533 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '533 Patent Asserted Claims are indefinite in whole, in part or in combination:[12]

Term	Relevant Claim(s)
"the light emitting diodes configured to generate an output optical beam with one or more optical wavelengths"	5
"the processed output signal"	5
"one of more detectors"	11

[12] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
"to select a fraction of the one or more optical wavelengths"	11

C. U.S. Patent No. 10,517,484

Pursuant to Rule 3-3(d), Defendants hereby identify grounds of invalidity for the '484 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. Defendants' invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '484 Patent Asserted Claims. Consequently, Defendants only identify the issues under 35 U.S.C. § 112 of which they are presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '484 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '484 Patent Asserted Claims at the time the '484 Patent was filed, at least as plaintiff appears to be asserting those limitations. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing

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date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '484 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '484 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '484 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '484 Patent fail to sufficiently enable the limtiations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '484 Patent fails to sufficiently describe or enable them as required by 35 U.S.C. § 112, ¶ 1:[13]

Term	Relevant Claim(s)
"wherein the output signal is indicative of one or more of the physiological parameters"	7-10
"increase the signal-to-noise ratio by comparing the first signal and the second signal"	7-10
"a property of at least some of the output signal is compared by at least one of the wearable device, the smart phone or tablet to a threshold"	8-10
"wherein the wearable device is at least in part configured to identify an object"	8-10
"wherein the wearable device is configured to use artificial intelligence to process at least a portion of the output signal"	10

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus.,*

[13] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Inc., 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '484 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '484 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '484 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 901 (2014). Several of the '484 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '484 Patent Asserted Claims are indefinite in whole, in part or in combination:[14]

Term	Relevant Claim(s)
"spatially separated detectors"	7-10
"increase the signal-to-noise ratio by comparing the first signal and the second signal"	7-10

[14] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
"wherein the detection system is configured to be synchronized to the light source"	7-10
"a cloud configured to receive over the wireless transmission link an output status"	7-10
"wherein the wearable device is at least in part configured to identify an object"	8-10
"gain configured to improve detection sensitivity"	9-10
"wherein the wearable device is configured to use artificial intelligence"	10

D. U.S. Patent No. 10,874,304

Pursuant to Rule 3-3(d), Defendants hereby identify grounds of invalidity for the '304 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. Defendants' invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '304 Patent Asserted Claims. Consequently, Defendants only identify the issues under 35 U.S.C. § 112 of which they are presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '304 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '304 Patent Asserted Claims

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at the time the '304 Patent was filed, at least as plaintiff appears to be asserting those limitations. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '304 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '304 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '304 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '304 Patent fail to sufficiently enable the limitations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '304 Patent fails to sufficiently describe or enable them as required by 35 U.S.C. § 112, ¶ 1:[15]

Term	Relevant Claim(s)
a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	11
the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources	11
wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal	11

[15] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate	13
the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	15, 21
wherein the first arc and the second arc are concentric	16, 22
the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources	19
a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters	19
wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate	20

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '304 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '304 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or

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because they omit elements that one of skill in the art would understand as part of the '304 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc*., 572 U.S. 898, 901 (2014). Several of the '304 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '304 Patent Asserted Claims are indefinite in whole, in part or in combination:[16]

Term	Relevant Claim(s)
a receiver configured to: … synchronize to the light source	11
the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources	11
wherein the measurement system is at least in part configured for selection or identification of an object	12
wherein the measurement system is configured to use artificial intelligence in making decisions	12
wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate	13
the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	15, 21
wherein the first arc and the second arc are concentric	16, 22
a receiver configured to: … synchronize to the modulation of the at least one of the semiconductor sources	19
the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by:	19

[16] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
differencing the first signal and the second signal, and increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources	
wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate	20

E. U.S. Patent No. 11,160,455

Pursuant to Rule 3-3(d), Defendants hereby identify grounds of invalidity for the '455 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. Defendants' invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '455 Patent Asserted Claims. Consequently, Defendants only identify the issues under 35 U.S.C. § 112 of which they are presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '455 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '455 Patent Asserted Claims at the time the '455 Patent was filed, at least as plaintiff appears to be asserting those limitations.

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Ariad Pharms., Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '455 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '455 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '455 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '455 Patent fail to sufficiently enable the limtiations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '455 Patent fails to sufficiently describe or enable them as required by 35 U.S.C. § 112, ¶ 1:[17]

Term	Relevant Claim(s)
A system for measuring one or more physiological parameters	1, 8, 15
the processed output signal	1, 8, 15
wherein the output signal is indicative of one or more of the physiological parameters	1, 8, 15
the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the [plurality of] semiconductor sources from an initial light intensity	1, 8, 15
increase the signal-to-noise ratio by comparing the first signal and the second signal	1, 8, 15
at least a portion of the one or more of the physiological parameters	1, 10
the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths	1

[17] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs	2, 9, 15
the light emitting diodes configured to generate an output optical light having one or more optical wavelengths	8, 15

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '455 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '455 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '455 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 901 (2014). Several of the '455 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art

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about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '455 Patent Asserted Claims are indefinite in whole, in part or in combination:[18]

Term	Relevant Claim(s)
spatially separated detectors	1, 2, 8, 9, 15
a plurality of detectors that are spatially separated from each other	1, 8, 15
wherein the detection system is configured to be synchronized to the light source	1, 8, 15
increase the signal-to-noise ratio by comparing the first signal and the second signal	1, 8, 15
the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths	1
the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the semiconductor sources from an initial light intensity	1
the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs	2, 9, 15
the light emitting diodes configured to generate an output optical light having one or more optical wavelengths	8, 15

F. U.S. Patent No. 12,193,790

Pursuant to Rule 3-3(d), Defendants hereby identify grounds of invalidity for the '790 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or

[18] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. Defendants' invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '790 Patent Asserted Claims. Consequently, Defendants only identify the issues under 35 U.S.C. § 112 of which they are presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '790 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '790 Patent Asserted Claims at the time the '790 Patent was filed, at least as plaintiff appears to be asserting those limitations. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '790 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '790 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '790 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '790 Patent fail to sufficiently enable the limtiations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '790 Patent fails to sufficiently describe or enable them as required by

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35 U.S.C. § 112, ¶ 1:[19]

Term	Relevant Claim(s)
"a wearable device for measuring one or more physiological parameters"	7
"signal is indicative of one or more of the physiological parameters"	7
"wherein the wearable device is at least in part configured to identify an object"	7

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '790 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '790 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '790 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in

[19] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc*., 572 U.S. 898, 901 (2014). Several of the '790 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '790 Patent Asserted Claims are indefinite in whole, in part or in combination:[20]

Term	Relevant Claim(s)
"a plurality of detectors that are spatially separated from each other"	7
"increase the signal-to-noise ratio by comparing the first signal and the second signal"	7
"wherein the wearable device is at least in part configured to identify an object"	7
"wherein the detection system is configured to be synchronized to the light source"	7

VII. Subject Matter Eligibility

Pursuant to the court's Standing Order Regarding Subject Matter Eligibility Contentions Applicable to All Patent Infringement Cases Assigned to Chief District Judge Rodney Gilstrap ("Order Regarding Eligibility"), Samsung provides the following Eligibility Contentions.

As described below, in Appendices A-F, and in Exhibits A101, B101, C101, D101, E101, and F101 (collectively "Appendix 101"), which are hereby incorporated by reference as if fully set forth herein, Defendants contend that the Asserted Claims of the Asserted Patents are drawn to subject matter that is not patentable under 35 U.S.C. § 101. Pursuant to section (a)(1) of the Order Regarding Eligibility, Appendix 101 contains a chart for each Asserted Patent identifying each

[20] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. Pursuant to section (a)(2)(A) of the Order Regarding Eligibility the charts of Appendix 101, read in conjunction with the discussion herein and in Appendices A-F, and together with the material described, referenced, or cited in the charts, further provide a description of the indsutry, at the relevant time, in which the Challenged Claims are alleged to be well understood, routine, and conventional, and the factual and legal basis therefor. Further, pursuant to sections (a)(2)(B) and (a)(3) of the Order Regarding Eligibility the charts of Appendix 101, read in conjunction with the discussion herein, and together with the material described, referenced, or cited in the charts, further provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Additionally, pursuant to section (b) of the Order Regarding Eligibility, Defendants are concurrently producing or making available for inspection and copying the materials on which Defendants presently seek to rely for subject-matter eligibility purposes. These prior art references and other materials are cited herein or in Appendices 101, A-F. For the avoidance of doubt, Defendants may rely on the materials identified in Section III, above. Without concession that expert testimony is necessary to resolve the subject matter eligibility of the Asserted Claims, Defendants reserve the right to further rely on expert testimony to be disclosed in accordance with the Docket Control Order. Defendants' search for prior art references, additional documentation, and/or corroborating evidence concerning prior art systems and devices is ongoing. Accordingly, Defendants reserve the right to supplement their production as Defendants obtain additional prior art references, documentation, and/or corroborating evidence concerning subject matter eligibility

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during the course of discovery.

Defendants reserve the right to supplement their document production pursuant to section (b) of the Order Regarding Eligibility as authorized by the Patent Local Rules, the Order Regarding Eligibility, or any other order of the Court.

A. U.S. Patent No. 9,055,868

Each of the Asserted Claims of the '868 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The '868 Patent Asserted Claims are unpatentable for failure to recite patent eligible subject matter.

The '868 Patent Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice Corp. Pty. Ltd. v. CLS Bank Intern.*, 573 U.S. 208, 216 (2014). By way of example, the Asserted Claims of the '868 Patent are generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for diagnostics. Although the Asserted Claims recite concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, '868 Patent at Figs. 1, 2, 4, 5 (illustrating exemplary embodiments via generic technology and functional language). This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting, processing, and storing light-based physiological data. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of diagnostic technique. Thus, under *Alice* Step 1, the Asserted Claims of the '868 Patent are directed to one or more ineligible concepts.

Under *Alice* Step 2, the '868 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a "handful of

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generic computer components configured to implement" the abstract idea. *See Alice*, 573 U.S. at 226. Semiconductor diodes and the claimed lens system have long been used in optical sensing; touchscreens, location sensors, applications, and wireless transceivers are common in smartphones; and terms like "host," "digital file," and "control logic" represent generic computer components. Optical systems, phone applications, and remote storage are well-known, and their combination follows the general trend toward interconnectivity. *See Chamberlain Grp., Inc. v. Techtronic Indus. Co.*, 935 F.3d 1341, 1347–48 (Fed. Cir. 2019) (noting the ability to "transmit[] data wirelessly" is "not a technological improvement, but rather simply a feature of wireless communication"). The '868 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. *See Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1354 (Fed. Cir. 2016) ("We have repeatedly held that such invocation of computers and networks that are not even arguably inventive are insufficient to pass the test of an inventive concept in the application of an abstract idea." (cleaned up)). Instead, the '868 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g., Intell. Ventures I LLC v. Cap. Fin. Corp.*, 850 F.3d 1332, 1342 (Fed. Cir. 2017). The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit A101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit A101 each Challenged Claim of the '868 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Exhibit A101 also identifies claim 7 as representative of the other Challenged Claims for purposes of the eligibility inquiry. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit A101, read in conjunction with the

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preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, Defendants provide the following description of the relevant industry at the relevant time. As of the alleged priority date for the '868 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the '868 Patent were conventional, routine, and well known in the medical device and wearable health tech industries. *See generally* Appendix A. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the '868 Patent. Instead, these concepts had been known for years and were the subject of many published articles and/or patents from around the world. The '868 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding Defendants' contentions that the Asserted Claims of the '868 Patent do not qualify as patent-eligible subject matter are contained in Exhibit A101.

B. U.S. Patent No. 9,651,533

Each of the Asserted Claims of the '533 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The '533 Patent Asserted Claims are unpatentable for failure to recite patent eligible subject matter.

The '533 Patent Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice*, 573 U.S. at 216. By way of example, the

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Asserted Claims of the ’533 Patent are generally directed to the abstract idea of collecting, processing, and storing light-based data for analysis. Although the Asserted Claims recite concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, ’533 Patent at 9:34-38, 2:26-29, 26:49-27:2. This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting, processing, and storing light-based data. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of measurement technique. Thus, under *Alice* Step 1, the Asserted Claims of the ’533 Patent are directed to one or more ineligible concepts.

Under *Alice* Step 2, the ’533 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a “handful of generic computer components configured to implement” the abstract idea. *See Alice*, 573 U.S. at 226. Semiconductor diodes, filters, and lenses have long been used in optical sensing; touchscreens, receivers, and transmitters are common in smartphones; and a “remote device” represents a conventional computer or storage unit. Optical systems, phone applications, and remote storage are well-known, and their combination follows the general trend toward interconnectivity. *See Chamberlain*, 935 F.3d at 1347–48. The ’533 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. Instead, the ’533 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g., Intell. Ventures*, 850 F.3d at 1342. The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit B101 contains a chart

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identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit B101, each Challenged Claim of the ’533 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Exhibit B101 also identifies claim 11 as representative of the other Challenged Claims for purposes of the eligibility inquiry. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit B101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, Defendants provide the following description of the relevant industry at the relevant time. As of the alleged priority date for the ’533 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the ’533 Patent were conventional, routine, and well known in the optoelectronics and laboratory analytical instrumentation industries. *See generally* Appendix B. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the ’533 Patent. Instead, these concepts had been known for years and were the subject of many published articles and/or patents from around the world. The ’533 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding Defendants’ contentions that the Asserted Claims of the ’533 Patent do not qualify as patent-eligible subject matter are contained in Exhibit B101.

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C. U.S. Patent No. 10,517,484

Each of the Asserted Claims of the ’484 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The ’484 Patent Asserted Claims are unpatentable for failure to recite patent eligible subject matter.

The ’484 Patent Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice*, 573 U.S. at 216. By way of example, the Asserted Claims of the ’484 Patent are generally directed to the abstract ideas of collecting, processing, and storing light-based physiological data for analysis. Although the Asserted Claims recite concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, ’484 Patent at 11:3-6, 32:45-65. This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting, processing, and storing light-based data. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of measurement technique. Thus, under *Alice* Step 1, the Asserted Claims of the ’484 Patent are directed to one or more ineligible concepts.

Under *Alice* Step 2, the ’484 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a “handful of generic computer components configured to implement” the abstract idea. *See Alice*, 573 U.S. at 226. Semiconductor diodes, detectors, and lenses have long been used in optical sensing; touchscreens, receivers, and transmitters are common in smartphones; and the cloud is ubiquitous with modern computing. Optical systems, phone applications, and remote storage are well-known, and their combination follows the general trend toward interconnectivity. *See Chamberlain*, 935

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F.3d at 1347–48. The ’484 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. Instead, the ’484 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g., Intell. Ventures*, 850 F.3d at 1342. The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit C101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit C101, each Challenged Claim of the ’484 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Exhibit C101 also identifies claim 8 as representative of the other Challenged Claims for purposes of the eligibility inquiry. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit C101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, Defendants provide the following description of the relevant industry at the relevant time. As of the alleged priority date for the ’484 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the ’484 Patent were conventional, routine, and well known in the medical device and wearable health tech industries. *See generally* Appendix C. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the ’484 Patent. Instead, these concepts had been

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known for years and were the subject of many published articles and/or patents from around the world. The ’484 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding Defendants’ contentions that the Asserted Claims of the ’484 Patent do not qualify as patent-eligible subject matter are contained in Exhibit C101.

D. U.S. Patent No. 10,874,304

Each of the Asserted Claims of the ’304 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The ’304 Patent Asserted Claims are unpatentable for failure to recite patent eligible subject matter.

The ’304 Patent Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice*, 573 U.S. at 216. By way of example, the Asserted Claims of the ’304 Patent are generally directed to the abstract ideas of collecting, processing, and storing light-based physiological data for analysis. Although the Asserted Claims recite concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, ’304 Patent at 13:21-25, 33:45-64. This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting, processing, and storing light-based physiological data. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of measurement technique. Thus, under *Alice* Step 1, the Asserted Claims of the ’304 Patent are directed to one or more ineligible concepts.

Under *Alice* Step 2, the ’304 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a “handful of

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generic computer components configured to implement" the abstract idea. *See Alice*, 573 U.S. at 226. Semiconductor diodes and receivers have long been used in optical sensing; touchscreens, receivers, and transmitters are common in smartphones; and the cloud is ubiquitous with modern computing. Optical systems, phone applications, and remote storage are well-known, and their combination follows the general trend toward interconnectivity. *See Chamberlain*, 935 F.3d at 1347–48. The '304 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. Instead, the '484 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g., Intell. Ventures*, 850 F.3d at 1342. The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit D101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit D101 each Challenged Claim of the '304 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Exhibit D101 also identifies claim 11 as representative of the other Challenged Claims for purposes of the eligibility inquiry. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit D101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, Defendants provide the following description of the relevant industry at the relevant time. As of the alleged

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priority date for the ’304 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the ’304 Patent were conventional, routine, and well known in the medical device and wearable health tech industries. *See generally* Appendix D. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the ’304 Patent. Instead, these concepts had been known for years and were the subject of many published articles and/or patents from around the world. The ’304 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding Defendants’ contentions that the Asserted Claims of the ’304 Patent do not qualify as patent-eligible subject matter are contained in Exhibit D101.

E. U.S. Patent No. 11,160,455

Each of the Asserted Claims of the ’455 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The ’455 Patent Asserted Claims are unpatentable for failure to recite patent eligible subject matter.

The ’455 Patent Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice*, 573 U.S. at 216. By way of example, the Asserted Claims of the ’455 Patent are generally directed to the abstract ideas of collecting, processing, and storing light-based physiological data for analysis. Although the Asserted Claims recite concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, ’455 Patent at 16:66-17:3, 45:43-62. This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting, processing, and storing light-based physiological data. Indeed, the patent does not purport to have invented or

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improved signal generation or processing; data transmission or remote storage; or any sort of measurement technique. Thus, under *Alice* Step 1, the Asserted Claims of the '455 Patent are directed to one or more ineligible concepts.

Under *Alice* Step 2, the '455 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a "handful of generic computer components configured to implement" the abstract idea. *See Alice*, 573 U.S. at 226. Semiconductor sources, lenses, and detectors have long been used in optical sensing; touchscreens, receivers, and transmitters are common in smartphones; and the combination of optical systems and smartphones follows the general trend toward interconnectivity. *See Chamberlain*, 935 F.3d at 1347–48. The '455 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. Instead, the '455 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g.*, *Intell. Ventures*, 850 F.3d at 1342. The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit E101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit E101 each Challenged Claim of the '455 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Exhibit E101 also identifies claim 1 as representative of the other Challenged Claims for purposes of the eligibility inquiry. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit E101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an

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identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, Defendants provide the following description of the relevant industry at the relevant time. As of the alleged priority date for the '455 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the '455 Patent were conventional, routine, and well known in the medical device and wearable health tech industries. *See generally* Appendix E. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the '455 Patent. Instead, these concepts had been known for years and were the subject of many published articles and/or patents from around the world. The '455 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding Defendants' contentions that the Asserted Claims of the '455 Patent do not qualify as patent-eligible subject matter are contained in Exhibit E101.

F. U.S. Patent No. 12,193,790

The Asserted Claim of the '790 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The '790 Patent Asserted Claim is unpatentable for failure to recite patent eligible subject matter.

The '790 Patent Asserted Claim is directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice*, 573 U.S. at 216. By way of example, the Asserted Claim of the '790 Patent is generally directed to the abstract idea of collecting and processing light-based data to determine physiological parameters. Although the Asserted Claim recites concrete, tangible components, the specification provides no technical details but instead

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describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, '790 Patent at 7:50-55, 84:63-67, 32:28-67. This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting and processing natural phenomena. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of measurement technique. Thus, under *Alice* Step 1, the Asserted Claim of the '790 Patent is directed to one or more ineligible concepts.

Under *Alice* Step 2, the '790 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a "handful of generic computer components configured to implement" the abstract idea. *See Alice*, 573 U.S. at 226. The claimed light source (e.g., LEDs), semiconductor diodes, lenses, detection system, detectors, and analog-to-digital converters are conventional and perform their ordinary, expected functions. The claimed enhancement of signal-to-noise ratio by increasing light intensity or by subtracting background signal is a well-known technique in signal processing and does not constitute an unconventional arrangement or improvement in technology. The '790 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. Instead, the '790 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g.*, *Intell. Ventures*, 850 F.3d at 1342. The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit F101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit F101 each Challenged Claim of the '790 Patent is directed to one or more abstract ideas and therefore is not

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directed to patent eligible subject matter. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit F101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, Defendants provide the following description of the relevant industry at the relevant time. As of the alleged priority date for the '790 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the '790 Patent were conventional, routine, and well known in the medical device and wearable health tech industries. *See generally* Appendix F. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the '790 Patent. Instead, these concepts had been known for years and were the subject of many published articles and/or patents from around the world. The '790 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding Defendants' contentions that the Asserted Claims of the '790 Patent do not qualify as patent-eligible subject matter are contained in Exhibit F101.

VIII. P. R. 3-4 – Productions

Pursuant to P.R. 3-4(a), each Defendant is concurrently producing and/or making available for inspection documents and other materials sufficient to show the operation of any aspects or elements of the Accused Products identified by Plaintiff in its P.R. 3-1(c) charts.

Additionally, and pursuant to P.R. 3-4(b), Defendants are concurrently producing a copy

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of each item of prior art identified herein. These prior art references and corroborating evidence are cited in attached invalidity claim charts in Appendices 101, A-F. Defendants will also make available for inspection any prior art systems or devices upon request to the extent Defendants acquire such systems or devices. References that were cited during prosecution of the Asserted Patents may not be contained in Defendants' production as they are not required to be under the local patent rules. Defendants' search for prior art references, additional documentation, and/or corroborating evidence concerning prior art systems and devices is ongoing. Accordingly, Defendants reserve the right to supplement their production as Defendants obtain additional prior art references, documentation, and/or corroborating evidence concerning invalidity during the course of discovery.

Defendants reserve the right to supplement their P. R. 3-4 document production pursuant to the Patent Local Rules and the orders of the Court.

Dated: June 3, 2025 Respectfully Submitted,

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By: */s/ Jared Smith*

Neil J. McNabnay
Texas Bar No. 24002583
mcnabnay@fr.com
Ricardo J. Bonilla
Texas Bar No. 24082704
rbonilla@fr.com
Rodeen Talebi
Texas Bar No. 24103958
talebi@fr.com
FISH & RICHARDSON P.C.
1717 Main Street, Suite 5000
Dallas, TX 75201
Tel: (214) 747-5070
Facsimile: (214) 747-2091

Jared Smith
California Bar No. 306576
jasmith@fr.com
FISH & RICHARDSON P.C.
12860 El Camino Real, Suite 400
San Diego, CA 92130
Tel: (858) 678-5070
Facsimile: (858) 678-5099

Joseph M. Sinopoli
D.C. Bar No. 90029472
sinopoli@fr.com
FISH & RICHARDSON P.C.
1000 Maine Avenue SW, Suite 1000
Washington, D.C. 20024
Tel: (202) 783-5070
Facsimile: (202) 783-2331

Counsel for Defendants
Fossil Group, Inc., Fossil Stores I, Inc., and Fossil Partners, L.P.

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/s/ Shaun Hassett
Shaun William Hassett
POTTER MINTON
102 North College, Suite 900
Tyler, TX 75702
903-525-2272
shaunhassett@potterminton.com

James A. Fussell
Jasjit S. Vidwan (pro hac vice)
Angeline L. Premraj
MAYER BROWN LLP
1999 K Street, NW
Washington, DC 20006-1101
Tel: 202-263-3000
jfussell@mayerbrown.com
jvidwan@mayerbrown.com
apremraj@mayerbrown.com

Shaun William Hassett
POTTER MINTON
102 North College, Suite 900
Tyler, TX 75702
903-525-2272
shaunhassett@potterminton.com

Attorneys for Defendant Oura Health Oy

/s/ Hyun-Joong (Daniel) Kim
Melissa R. Smith
State Bar No. 24001351
GILLAM & SMITH, LLP
303 South Washington Avenue
Marshall, Texas 75670
Telephone: (903) 934-8450
Facsimile: (903) 934-9257
melissa@gillamsmithlaw.com

Steven Pepe
(NY Bar No. 2810430)
Hyun-Joong (Daniel) Kim
(NY Bar No. 5304761)
ROPES & GRAY LLP

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1211 Avenue of the Americas
New York, NY 10036-8704
Telephone: (212) 596-9000
Facsimile: (212) 596-9090
Steven.Pepe@ropesgray.com

David S. Chun
(CA Bar No. 315958)
ROPES & GRAY LLP
525 University Ave, 8th Floor
Palo Alto, CA 94301
Telephone: (650) 617-4000
Facsimile: (650) 617-4090
David.Chun@ropesgray.com

Attorneys for Defendants Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.

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EXHIBIT D101

Preliminary Eligibility Contentions for U.S. Patent No. 10,874,304

Based on Omni's apparent positions, as best they can be deciphered, as to the scope of asserted claims of U.S. Patent No. 10,874,304, the chart below provides Defendants' current contentions regarding the patent ineligibility of each asserted claim.

This disclosure is not an admission that Defendants concede any claim construction implied or suggested by Omni's apparent positions as to the scope of the patent's claims, nor is it an admission by Defendants that any of their products are covered by or infringe the patent's claims, particularly when they are properly construed and applied. Defendants are not taking any claim construction positions through this disclosure, including whether the preamble is a limitation.

Defendants reserve the right to rely on additional citations or sources of evidence that also may be applicable, or that may become applicable in light of claim construction, changes in Omni's infringement contentions, and/or information obtained during discovery as the case progresses. Defendants further reserve the right to amend or supplement this claim chart at a later date as more fully set forth in the Invalidity and Subject Matter Eligibility Contentions.

The asserted claims, claims 11, 14-16, 19-22, are drawn to patent-ineligible subject matter under 35 U.S.C. § 101. The claims are generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. And none of the claims contain an "'inventive concept' . . . sufficient to ensure that the patent in practice amounts to *significantly more* than a patent upon the ineligible concept itself." *See Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 573 U.S. 208, 217–18 (2014) (emphasis added).

Claim 11 of the '304 patent is representative.

Claim 11 may be treated as representative for purposes of § 101 because the asserted claims are "substantially similar and linked to the same abstract idea." *See Content Extraction & Transmission LLC v. Wells Fargo Bank, Nat'l Ass'n*, 776 F.3d 1343, 1348–49 (Fed. Cir. 2014). Of the asserted claims, claims 11 and 19 are independent—Claim 11 is slightly broader, but both essentially recite systems for collecting, processing, and storing light-based physiological data. *See* '304 patent at cls. 11, 19.

The remaining asserted claims (14-16, 20-22) narrow the scope of either Claim 11 or Claim 19, but all remain directed to the same abstract idea: collecting, processing, and storing light-based data. For example, claims 14, 15, and 16 add detail to Claim 11 by specifying types of "semiconductor sources" (Claim 14) and the arrangement of the "detectors" (claims 15-16). Claims 20, 21, and 22 similarly add detail to Claim 19 by providing a conventional means for improving signal-to-noise ratio ("increasing a pulse rate") (Claim 20) and specifying the arrangement of "detectors" (Claims 21-22). *See* Ex. D1-D19. Because none of the dependent limitations amount to meaningful limitations for purposes of § 101, none require separate evaluation. *See, e.g.*, *Content Extraction*, 776 F.3d at

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1348–49 (explaining that "well-known, routine, and conventional" features are not meaningful limitations because they cannot provide an "inventive concept"); *Cleveland Clinic Found. v. True Health Diagnostics LLC*, 859 F.3d 1352, 1360 (Fed. Cir. 2017) (holding that the recitation of "known methods of detecting" physiological parameters does not provide an inventive concept); *Clear with Computers, LLC v. Dick's Sporting Goods, Inc.*, 21 F. Supp. 3d 758, 763 (E.D. Tex. 2014) ("Nor is a claim meaningfully limited if it contains only insignificant or token pre- or post-solution activity—such as identifying a relevant audience, a category of use, field of use, or technological environment." (cleaned up)).

Because Claim 11 is broader, directed to the same general abstract idea, and, explicitly or implicitly, covers many of the same limitations as Claim 19, Claim 11 should be treated as representative for purposes of § 101. *See PPS Data, LLC v. Jack Henry & Assocs., Inc.*, 404 F. Supp. 3d 1021, 1031–32 (E.D. Tex. 2019) (explaining that a defendant can make out a "prima facie case demonstrating representativeness" through "an analysis tethered to the claim language" showing "that there are no legally relevant distinctions between the claim identified as representative and the remaining asserted claims").

***Alice* Step One: The asserted claims are generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis.**

The *Alice* test requires the Court to look at the "focus of the claimed advance over the prior art to determine if the claim's character as a whole is directed to excluded subject matter." *Affinity Labs of Tex., LLC v. DIRECTV, LLC*, 838 F.3d 1253, 1257 (Fed. Cir. 2016) (cleaned up). The '304 patent discusses a need for non-invasive monitoring of blood constituents with adequate sensitivity and selectivity. *See* '304 patent at 4:52–5:3. According to the patent, readings from near-infrared spectroscopy, a common method of non-invasive blood monitoring, are often inaccurate due to either a weak signal or interference (noise). *Id.* The '304 patent purports to address this shortcoming in two ways: (1) by adjusting the light intensity to increase signal levels for purposes of data collection and (2) by using "mathematical modeling and signal processing methodologies" to "reduce the interference" (noise). *Id.* at 20:5–25. The patent further explains that the "measurement device may also benefit from communicating the data to the 'cloud'" to provide a "panoramic, high-definition, relatively comprehensive view of a patient" that doctors and patients can analyze. *Id.* at 33:26–44.

Claim 11 is thus generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. The claimed system is configured to first measure a physiological parameter by observing its relationship to light—specifically, it measures the correlation between two naturally occurring phenomena, which is an abstract natural law. *See, e.g.*, *id.* at cl. 11, 6:48–7:14; *Cleveland Clinic*, 859 F.3d at 1361 (holding claims directed to measuring the relationship between naturally occurring phenomena are directed to an abstract natural law); *Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 788 F.3d 1371, 1376 (Fed. Cir. 2015) (holding that claims "generally directed to detecting the presence of a naturally occurring thing" are abstract). The system is supposedly adapted to improve signal-to-noise ratio while taking measurements by providing a stronger signal ("increasing a light

intensity") and using basic, conventional math to filter out noise ("differencing the first signal and the second signal"). The system may then transmit the light-based physiological data to a smart phone or tablet, which processes, stores, and displays the data, and then onward to a cloud, for additional processing and storage.

Claim 11 amounts to nothing more than a compilation of abstract ideas. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of measurement technique. The "use of a mathematical calculation, even one that yields different or better results, does not render patent eligible subject matter." *In re Bd. of Trs. of Leland Stanford Junior Univ.*, 991 F.3d 1245, 1251 (Fed. Cir. 2021). Nor does "[a]dding one abstract idea (math) to another abstract idea" (e.g., measuring natural phenomena). *See RecogniCorp, LLC v. Nintendo Co., Ltd.*, 855 F.3d 1322, 1327 (Fed. Cir. 2017). And collecting, processing, storing, and transmitting information have long been held abstract. *See, e.g.*, *Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1353–54 (Fed. Cir. 2016) (collecting cases); *Content Extraction*, 776 F.3d at 1347 ("The concept of data collection, recognition, and storage is undisputedly well-known.").

Although Claim 11 requires concrete, tangible components such as a "wearable measurement device," "semiconductor sources," and a "smart phone or tablet," "the specification makes clear that the recited physical components merely provide a generic environment in which to carry out the abstract idea" of collecting, processing, and storing data. *See In re TLI Commc'ns LLC Pat. Litig.*, 823 F.3d 607, 611–12 (Fed. Cir. 2016) (finding claims "directed to the use of conventional or generic technology in a nascent but well-known environment" to be abstract). In fact, the specification provides no technical details for the tangible components, but instead describes them—both individually and collectively—in generic and functional terms. *See infra*, *Alice* Step Two. So instead of providing any new or useful system, Claim 11 recites the abstract idea of collecting, processing, and storing light-based physiological data through conventional technology and result-oriented steps. *See In re Gopalan*, 809 F. App'x 942, 945–46 (Fed. Cir. 2020).

***Alice* Step Two: The asserted claims do not contain a transformative inventive concept.**

Claim 11 likewise contains no inventive concept that transforms the abstract idea into patent-eligible subject matter.

The claimed elements, individually and as an ordered combination, recite only a "handful of generic computer components configured to implement" the abstract idea. *See Alice*, 573 U.S. at 226. Semiconductor diodes and receivers have long been used in optical sensing; touchscreens, receivers, and transmitters are common in smartphones; and the cloud is ubiquitous with modern computing. Optical systems, phone applications, and remote storage are well-known, and their combination follows the general trend toward interconnectivity. *See* Ex. D1-D19; Cover Pleading at § III.G; *Chamberlain Grp., Inc. v. Techtronic Indus. Co.*, 935 F.3d 1341, 1347–48 (Fed. Cir. 2019) (noting the ability to "transmit[] data wirelessly" is "not a technological improvement, but rather simply a feature of wireless communication").

Claim 11, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. *See Elec. Power Grp.*, 830 F.3d at 1354 ("We have repeatedly held that such invocation of computers and networks that are not even arguably inventive are insufficient to pass the test of an inventive concept in the application of an abstract idea." (cleaned up)). Instead, Claim 11 recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g., Intell. Ventures I LLC v. Cap. Fin. Corp.*, 850 F.3d 1332, 1342 (Fed. Cir. 2017) ("[T]he claim language here provides only a result-oriented solution, with insufficient detail for how a computer accomplishes it. Our law demands more."). In other words, the claim does not offer any specific technological solution to improve the functioning of the sensors, hardware, or anything else, but instead describes an interconnected system of conventional components that mirrors existing fitness tracking paradigms.

Finally, Claim 11 follows a generic data-processing pipeline, describing a system that: (1) collects, (2) processes, (3) transmits, and (4) stores data. This is a classic data-processing and transmission sequence—the kind the Federal Circuit has consistently held to be ineligible when implemented using generic computing equipment. *See, e.g.*, *Two-Way Media Ltd. v. Comcast Cable Commc'ns, LLC*, 874 F.3d 1329, 1339 (Fed. Cir. 2017) (holding that a "conventional ordering of steps . . . with conventional technology to achieve its desired result" is insufficient to provide an inventive concept). And the specification confirms that each of the result-oriented claim elements can be carried out by generic hardware operating in a conventional fashion. *See, e.g.*, '304 patent at 13:21–25 ("In one embodiment, the 'optical light' and/or 'optical beam' and/or 'light beam' may originate from a fiber, a fiber laser, a laser, a light emitting diodes, a lamp, a pump laser, or a light source."); *id.* at 33:45–64 (reciting generic technologies, including "a transmitter," "a processor," "wireless technologies such as Bluetooth," and recognizing that "other devices could be used and are included in the scope of this disclosure"). At bottom, Claim 11, whether considered limitation-by-limitation or as a whole, does not sufficiently transform the abstract idea of collecting, processing, and storing physiological data into a patentable invention.

'304 Patent – Claim 11	**Subject Matter Eligibility Contentions**
[11pre] A measurement system comprising:	Claim 11 is directed to an abstract idea. And it contains no inventive concept sufficient to ensure that the claim amounts to significantly more than the patent-ineligible concept itself. Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. *See, e.g.*, *AI Visualize, Inc. v. Nuance Commc'ns, Inc.*, 97 F.4th 1371, 1378–79 (Fed. Cir. 2024); *In re TLI Commc'ns*

	LLC Patent Litig., 823 F.3d 607, 611–13 (Fed. Cir. 2016); *Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1353–54 (Fed. Cir. 2016); *Intell. Ventures I LLC v. Cap. Fin. Corp.*, 850 F.3d 1332, 1340–41 (Fed. Cir. 2017); *Univ. of Fla. Rsch. Found., Inc. v. Gen. Elec. Co.*, 916 F.3d 1363, 1367–68 (Fed. Cir. 2019); *CardioNet, LLC v. InfoBionic, Inc.*, 816 F. App'x 471, 475–77 (Fed. Cir. 2020); *In re Bd. of Trs. Of Leland Stanford Junior Univ.*, 991 F.3d 1245, 1250–51 (Fed. Cir. 2021); *Audio Evolution Diagnostics, Inc. v. United States*, 160 Fed. Cl. 513, 526–27 (2022), *aff'd*, No. 2023-1096, 2024 WL 2143376 (Fed. Cir. May 14, 2024); *Braemar Mfg., LLC v. ScottCare Corp.*, 816 F. App'x 465, 470 (Fed. Cir. 2020); *Philips N. Am. LLC v. Fitbit LLC*, 626 F. Supp. 3d 292, 306–09 (D. Mass. 2022); *Two-Way Media Ltd. v. Comcast Cable Commc'ns, LLC*, 874 F.3d 1329, 1337–39 (Fed. Cir. 2017); *In re Gopalan*, 809 F. App'x 942, 945–46 (Fed. Cir. 2020); *Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 788 F.3d 1371, 1376 (Fed. Cir. 2015); *Cleveland Clinic Found. v. True Health Diagnostics LLC*, 859 F.3d 1352, 1361 (Fed. Cir. 2017); *RecogniCorp, LLC v. Nintendo Co., Ltd.*, 855 F.3d 1322, 1327 (Fed. Cir. 2017); *Chamberlain Grp., Inc. v. Techtronic Indus. Co.*, 935 F.3d 1341, 1346–48 (Fed. Cir. 2019); *Content Extraction & Transmission LLC v. Wells Fargo Bank, Nat'l Ass'n*, 776 F.3d 1343, 1347 (Fed. Cir. 2014). Claim 11 also contains no inventive concept. At the time of the alleged invention, the elements of Claim 11 were well-understood, routine, and/or conventional. Claim 11 employs well-known components or functionality, as shown for example in Defendants' invalidity contentions, which is not enough to impart patent eligibility. *See, e.g.*, Ex. D1-D19 at all disclosures for [11pre]; Cover Pleading at § III.G.

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[11a] a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11a]; Cover Pleading at § III.G.
[11b] the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11b]; Cover Pleading at § III.G.
[11c] the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11c]; Cover Pleading at § III.G.
[11d] the wearable measurement device further comprising a receiver configured to:	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11d]; Cover Pleading at § III.G.
[11e] receive and process at least a portion of the analysis output beam reflected or transmitted from the sample,	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis.

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	At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11e]; Cover Pleading at § III.G.
[11f] generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11f]; Cover Pleading at § III.G.
[11g] synchronize to the light source,	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11g]; Cover Pleading at § III.G.
[11h] capture light while the semiconductor sources are off and convert the captured light into a first signal,	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11h]; Cover Pleading at § III.G.
[11i] capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11i]; Cover Pleading at § III.G.

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[11j] wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11j]; Cover Pleading at § III.G.
[11k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11k]; Cover Pleading at § III.G.
[11l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	As explained above, Claim 11 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. D1-D19 at all disclosures for [11l]; Cover Pleading at § III.G.

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EXHIBIT D1

U.S. Pat. No. 10,874,304 in view of U.S. Patent Publication No. 2015/0057511 to Amar Sarbbasesh Basu ("Basu")

As described in detail below, Basu (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either alone in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D2-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Basu. The cited portions of Basu are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Basu. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Basu "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Basu does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Basu (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Basu anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

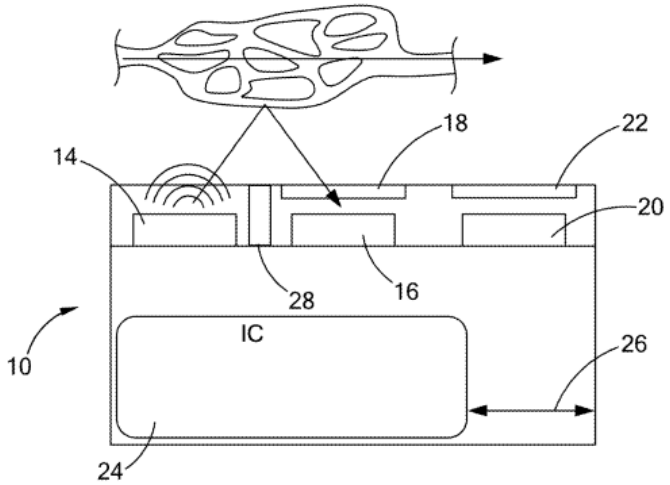
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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’304 Patent	Basu
Claim 1	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Basu discloses or renders obvious a measurement system. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at Abstract. 1. An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and a wearable carrier accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin. Basu at Claim 1. The present invention relates to a device, a system, and a method for vascular health monitoring of a person. More particularly, the invention relates to a sensor suitable for remote patient monitoring. Basu at [0002].

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	According to a first aspect of the invention, an optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. Basu at [0007]. In a first approach, this device utilizes electronic optical proximity sensors (OPS) 10 to sense a patient's heart rate. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. Variations of OPS are widely used for non-contact distance measurement in a variety of applications. In smart phones, for example, OPS detect when a phone is placed in a pocket, triggering touch-screen locking. In factory robotics, OPS are used for motion feedback control. In many industrial and consumer applications, OPS serve as touchless switches and gesture sensing devices in personal notebooks, vending machines, sanitary dispensers, lavatories, dimming control, and video games. Basu at [0035].

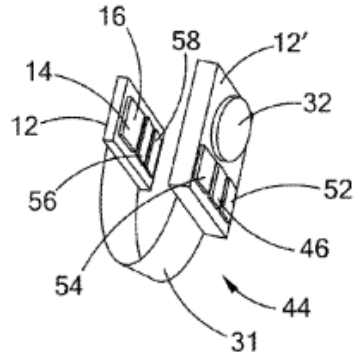
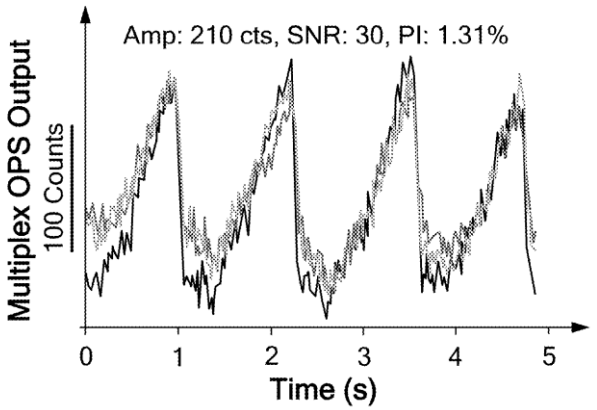
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’304 Patent	Basu
	 FIG. 1 Basu at Fig. 1. OPS 10 can provide heart rate sensing comparable to commercial reflectance photoplethosymography devices and reflectance pulse oximeters, but in a much more compact package with a printed circuit board (PCB) area less than about 16 mm2 compared to typical detectors with a PCB area of 200 mm2 for all the individual components. More importantly the power consumption is less than about 200 μW compared to 10 mW for conventional photoplethysmography sensors. This order of magnitude improvement makes it possible to make a 24 hour heart rate sensor integrated in a wearable carrier, and one small enough to be worn unobtrusively in on a finger, ear, etc. Due to the low power consumption, a battery 32 holding a charge for operating the OPS for at least 24 hours can be unobtrusively small. For example, FIGS. 3B and 3C show an OPS 10 integrated in wearable carrier in the form of a finger ring 44, in which the ring shape is formed by a flexible cable 30. The cable 30 connects the OPS 10 with a rechargeable battery 32 providing for a sufficient capacity for at least several hours of monitoring, preferably at least 24 hours. FIG. 4, for example, is a picture of an OPS 10 used for photoplethysmography placed on a finger tip. Although the capillary bed is smaller than the fingertip, the presence of reflective bone backing formed by the finger bone improves the reflected signal. Basu at [0040].

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’304 Patent	Basu
	As further shown in FIG. 11, a “cloud-based” RPM infrastructure can actively manage cardiovascular health. Using OPS technology, cardiovascular parameters can be monitored on a 24-hour ambulatory basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record. These data will then be available to the patient's physician, providing an effective tool for quantitative assessment, without bias from “white-coat” alteration, thus providing a means for evidence-based medical management. In emergency situations, notifications can be sent to a medical response team and family members. An RPM-driven model will dramatically reduce the cost of chronic cardiovascular care through earlier detection of impending decompensation, white also improving health outcomes by motivating the patient to actively monitor health and take preventative measures. Basu at [0064]. In another example shown in FIG. 13, a miniature OPS device for an earlobe in the form of an ear clip 44 may have PCB boards on both sides of the earlobe. In the example of FIG. 13, the sensors are configured to be arranged on the underside of the earlobe, facing the earlobe. The wireless communication devices are arranged on the outside. The boards may, for example, be connected as shown with a clip 31 with embedded electrical connections. Alternatively, a post connected to one board may snap into a receiving socket connected to the other board. The latter solution provides a secure attachment of the sensor for individuals with pierced ears. Use of the ear as a sensor location may be preferred for minimizing motion artifacts though use of accelerometers and other motion correction measurements are possible. In addition to a clip the OPS sensors could be placed against the anterior auricular region or posterior auricular region instead of the lobe itself incorporated into a discrete accessory. Note the OPS sensor also could be integrated into multifunctional earpiece devices such as blue-tooth headsets. Basu at [0072].

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’304 Patent	Basu
	 FIG. 13 Basu at Fig. 13.  FIG. 16 Basu at Fig. 16. For pulse oximetry, the Silicon Labs Si1143 was used, a triple-LED digital OPS 10, as is schematically indicated in FIG. 17. The chip 48 includes a photodiode 50 with FWHM spectral bandwidth of 600-1000 nm, 3 LED drivers, and a signal conditioning logic on the embedded IC. Unlike the VCNL4000, the

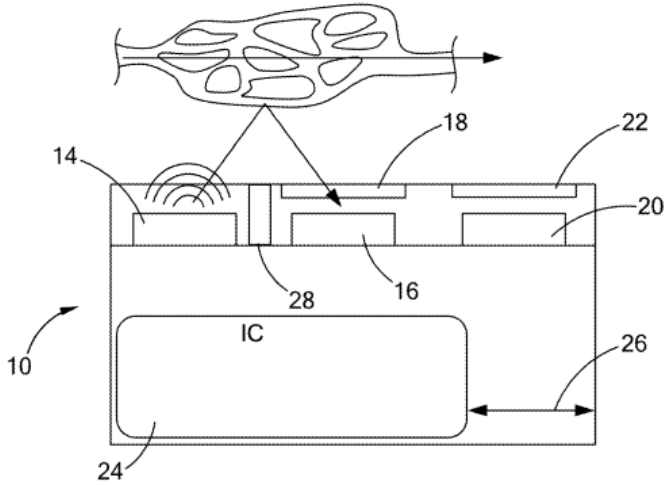
’304 Patent	Basu
	Si1143 does not include the LEDs on the chip 48 itself. Surface mount IR LEDs 14, 14′, and 15 (OSRAM) were placed within 3 mm on either side of the photodiode. The half angle of the chosen LEDs 14, 14′, and 15 is 22 degrees, which limits the light leakage. Each LED current can be set between 5.6 and 360 mA. The Si1143 uses time multiplexing to measure the reflectance from two or three LEDs on a single photo detector. Like the VCNL4000, it uses short LED pulses (25 μsec), which reduces the power consumption of the system. With three 100 mA LEDs 14, 14′, and 15 operating at a 100 Hz data rate, the power consumption is still less than about 800 μW. The Si1143 also includes an I2 C bus interface 26 for sensor configuration and reading sensor data. The ambient light sensor 20 included on the chip 48 can be used for sensing whether the chip 48 has been placed in contact with the skin. Results from the Multi-LED are shown in FIG. 16. This experiment used three LEDs 14, 14′, and 15 placed 3 mm from a photo detector 50 formed by a Si1143 sensor as indicated in FIG. 15. A single measurement was taken at the fingertip at a fixed, moderate pressure. The three simultaneous photoplethysmography waveforms are shown in the same graph. The signal-to-noise ratio is somewhat lower than similar measurements taken with the VCNL4000, but this is likely due to the smaller LED current used (30 mA vs. 100 mA). The pulsation index is slightly larger, which may be due to the placement or emission characteristics of the LEDs. The SPO2 measurement can be found by taking the ratio of amplitudes in two LED channels. This calculation is performed by a microcontroller (not shown). The measurement protocol for the Si1143 is identical to the single-LED experiment. Although commercially available VCNL4000 and Si1143 sensors were used for the OPS 10, this technique can be used with any suitable digital OPS 10, reflective light sensor, photo interrupter, or similar component. Examples include (but are not limited to) the OSRAM 770/773, the Avago APDS-9190, and the Intersil ISL29011/21/27/28. Examples of Multi-LED optical proximity sensors include the Rohm BH1771GLC, as well as the Si1141/42/43 series. While the schematic setup shown in FIG. 17 for operating a pulse oximetry sensor according to the present invention depicts three LEDs 14, 14′, and 15, two LEDs, for example LED 14 and LED 15, are sufficient for performing the required measurements as discussed above. Basu at [0104]-]0108].

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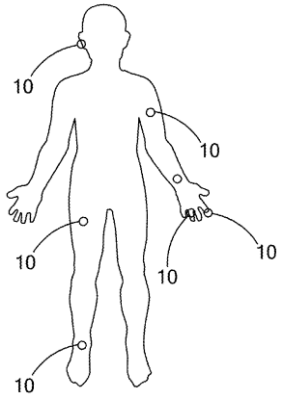
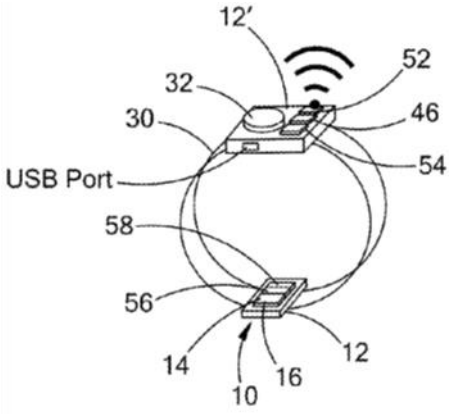
’304 Patent	Basu
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Basu discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths. 1.An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and a wearable carrier accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin. Basu at Claim 1. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several

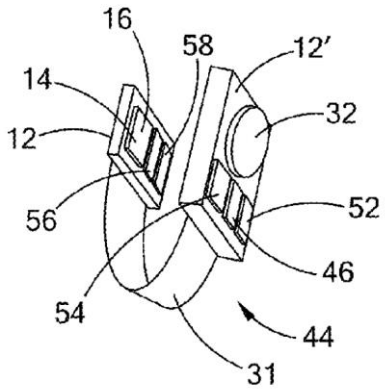
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’304 Patent	Basu
	sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract]. According to further embodiments of the invention, a single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Basu at [0008]. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery or vascular stiffness this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health. Basu at [0009]. This invention includes new technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor. The blood pressure may be indirectly measured using pulse wave velocity by placing several sensors in different locations along an artery. In this manner, vascular conditions can be detected, such as restricted blood flow. Basu at [0034]. OPS 10 can provide heart rate sensing comparable to commercial reflectance photoplethosymography devices and reflectance pulse oximeters, but in a much more compact package with a printed circuit board (PCB) area less than about 16 mm2 compared to typical detectors with a PCB area of 200 mm2 for all the individual components. More importantly the power consumption is less than about 200 μW compared to 10 mW for conventional photoplethysmography sensors. This order of magnitude improvement makes it possible to make a 24 hour heart rate sensor integrated in a wearable carrier, and one small enough to be worn unobtrusively in on a finger, ear, etc. Due to the low power consumption, a battery 32 holding a charge for operating the OPS for at least 24 hours can be unobtrusively small. For example, FIGS. 3B and 3C show an OPS 10 integrated in wearable carrier in the form of a finger ring 44, in which the ring shape is formed by a flexible cable 30. The cable 30 connects the OPS 10 with a rechargeable battery 32 providing for a sufficient capacity for at least several hours of monitoring,

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	preferably at least 24 hours. FIG. 4, for example, is a picture of an OPS 10 used for photoplethysmography placed on a finger tip. Although the capillary bed is smaller than the fingertip, the presence of reflective bone backing formed by the finger bone improves the reflected signal. Basu at [0040]. FIGS. 3D and 1 illustrate the general working mechanism. The OPS 10 is placed in direct contact with the skin, near a capillary bed 40. Ideal locations include the fingertip, earlobe, or forehead. A protective overlay (not shown in this figure) can be added if desired. The IR LED 14 emits light into the tissue, where it experiences diffuse reflection from the tissue and capillary bed 40. This establishes a baseline reflectance signal at the IR photodiode 16. When a pressure wave propagates through the capillary bed 40, the signal falls slightly (0.5-5%) due to increased light scattering. The change is detected by an amplification and signal processing circuitry in the IC 24 embedded in the OPS 10. In the case of an earlobe or fingertip sensor, a metal backing can be placed on the opposite side of the earlobe or fingertip to improve the reflectance signal. In some embodiments, the metal backing may be provided by the battery 32. Basu at [0045].  FIG. 1

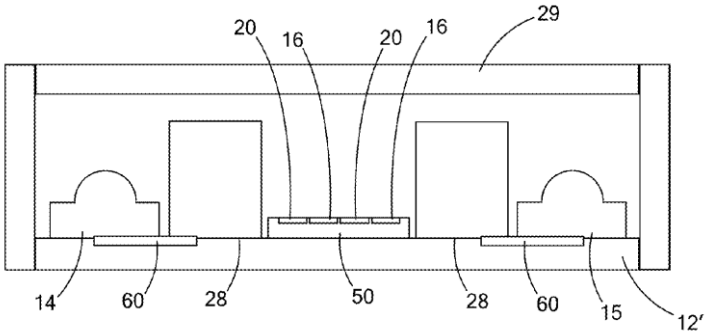
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	Basu at Fig. 1.  FIG. 8 Basu at Fig. 8.  FIG. 12 Basu at Fig. 12.

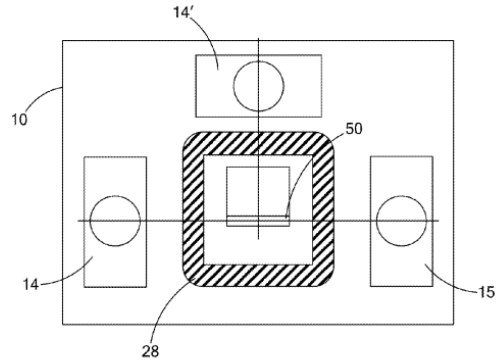
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	FIG. 12: A schematic of an alternative proposed sensor system for heart rate monitoring, with parts drawn approximately to scale; Basu at [0026].  FIG. 13 Basu at Fig. 13. FIG. 13: A schematic of a further alternative proposed sensor system for heart rate monitoring, with parts drawn approximately to scale; Basu at [0027]. These technologies are integrated with a Bluetooth module 46 or another suitable wireless technology and with rechargeable batteries 32 in a small package, making the sensor assembly wireless and comfortably wearable throughout the day. OPS 10 and a low power Bluetooth transmitter can be integrated into the underside of a ring 44 or placed on a separate board 12′ along with the battery 32. Beside Bluetooth technology and Bluetooth Low Energy technology, any other low-power transmission protocol is suitable for communication with a computer for evaluation. Basu at [0062].

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	The OPS 10 was placed with fixed pressure in multiple locations, including the fingertip, an earlobe, and upper finger (to simulate a ring sensor). A metal backing was added to the OPS 10 on the opposite side of the earlobe to improve the reflectance signal. One example of an OPS formed as an ear clip 44 is shown in FIG. 13. Those elements that are placed on the board 12′ of the battery 32 in FIG. 12 are placed on the outside of the ear clip 44 and face away from the person's head, shown in FIG. 13 on the right side. The battery 32 may additionally be arranged to provide a reflective surface for the light emitted by the LED 14 toward the photodiode 16. A button cell battery is well suited for this purpose due to its planar metallic end facing the LED 14 and the photodiode 16. The OPS 10 is placed on the inside of the ear clip 44, facing the earlobe from the side of the person's head. It is evident, that the locations may also be reversed without leaving the scope of the present invention. Basu at [0088]. In yet a further development, a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. For example, if one LED 15 emits red light and a second LED 14 emits light in the near infrared, a pulse oximetry sensor can be realized with a very small size. FIG. 14 illustrates how one red LED 15 and one IR LED 14 are arranged on opposite sides of a photo detector 50 that includes photodiodes 16 and 20 sensitive to different spectral ranges, here red for photodiode 20 and near IR for photodiode 16. Each of the LEDs 14 and 15 is separated from the photo detector by an optical barrier 28. The optical barriers 28 do not touch the transparent cover 29 that separates the LEDS 14 and 15, the optical barriers 28, and the photo detector 50 from the human skin because a direct contact between the optical barrier 28 and the cover 29 might result in a bad signal quality. The height of the optical barriers 28 may be derived from empirical measurements until an optimum configuration is found. The arrangement of FIG. 14 further shows copper barriers 60 embedded in circuit board 12′ extending from underneath each of the LEDs 14 and 15 to a location underneath the adjacent optical barrier 28, respectively, to avoid a light leakage through the circuit board 12′ from the LEDs 14 and 15 to the photodiodes 16 and 20. Basu at [0093].

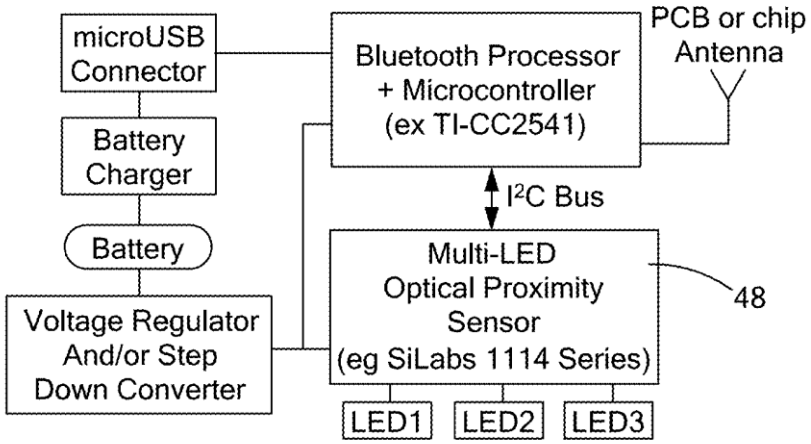
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	The use of a multi-LED OPS 10 for pulse oximetry is shown schematically in FIGS. 14, 15, 16, and 17. The multi-LED OPS 10 detects signals from multiple discrete LEDs 14 and 15, and optionally 14′, which can be multiplexed on a single photo detector 50 equipped with photodiodes 16 of infrared detection and photodiodes 20 for detecting red light. A typical sensor shown in 17 includes the photo detector 50, 2 or more LED drivers, and electronics for signal conditioning and multiplexing the data channels on a common circuit board 48. The LEDs 14 and 15, and optionally 14′, are added separately to the circuit board, along with an optical barrier 28 to reduce leakage if desired as shown in 15. While this increases the chip count, it does allow flexibility in positioning the LEDs 14 and 15, and 14′ for either transmittance or reflectance mode, and in choosing the appropriate wavelengths. Basu at [0096].  FIG. 14 Basu at Fig. 14.

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	 FIG. 15 Basu at Fig. 15. Thus, suitable wavelengths for pulse oximetry are in the range of about 600 nm to 700 nm for the red LED 15, preferably between about 650 nm and 670 nm, and about 850 nm to 950 nm, preferably about 900 nm to 940 nm for the near infrared LED 14. Notably, a deviation from the preferred wavelengths is feasible and may make the sensor 10 cheaper due to the availability of commercially produced LEDs 14 and 15. The two LEDs 14 and 15 may be pulsed. Optionally, the two LEDs 14 and 15 may be pulsed at different frequencies through frequency multiplexing. Alternatively. The LEDs 14 and 15 may be pulsed in an alternating mode through time multiplexing. Pulsing the LEDs 14 and 15 promotes an easy distinction of the two signals where both signals are received by the same photo detector. Basu at [0099]. For pulse oximetry, the Silicon Labs Si1143 was used, a triple-LED digital OPS 10, as is schematically indicated in FIG. 17. The chip 48 includes a photodiode 50 with FWHM spectral bandwidth of 600-1000 nm, 3 LED drivers, and a signal conditioning logic on the embedded IC. Unlike the VCNL4000, the Si1143 does not include the LEDs on the chip 48 itself. Surface mount IR LEDs 14, 14′, and 15 (OSRAM) were placed within 3 mm on either side of the photodiode. The half angle of the chosen LEDs 14, 14′, and 15 is 22 degrees, which limits the light leakage. Each LED current can be set between 5.6 and 360 mA. The Si1143 uses time multiplexing to measure the reflectance from two or three LEDs on a single photo detector. Like the VCNL4000, it uses short LED pulses (25 μsec), which reduces the power consumption of the system. With three 100 mA LEDs 14, 14′, and 15 operating at a 100 Hz data

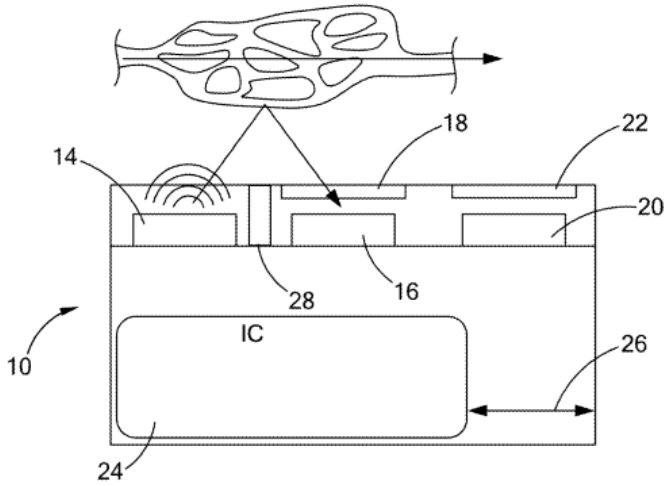
’304 Patent	Basu
	rate, the power consumption is still less than about 800 μW. The Si1143 also includes an I2 C bus interface 26 for sensor configuration and reading sensor data. The ambient light sensor 20 included on the chip 48 can be used for sensing whether the chip 48 has been placed in contact with the skin. Basu at [0104]. Results from the Multi-LED are shown in FIG. 16. This experiment used three LEDs 14, 14′, and 15 placed 3 mm from a photo detector 50 formed by a Si1143 sensor as indicated in FIG. 15. A single measurement was taken at the fingertip at a fixed, moderate pressure. The three simultaneous photoplethysmography waveforms are shown in the same graph. The signal-to-noise ratio is somewhat lower than similar measurements taken with the VCNL4000, but this is likely due to the smaller LED current used (30 mA vs. 100 mA). The pulsation index is slightly larger, which may be due to the placement or emission characteristics of the LEDs. The SPO2 measurement can be found by taking the ratio of amplitudes in two LED channels. This calculation is performed by a microcontroller (not shown). Basu at [0105]. While the schematic setup shown in FIG. 17 for operating a pulse oximetry sensor according to the present invention depicts three LEDs 14, 14′, and 15, two LEDs, for example LED 14 and LED 15, are sufficient for performing the required measurements as discussed above. Basu at [0108].

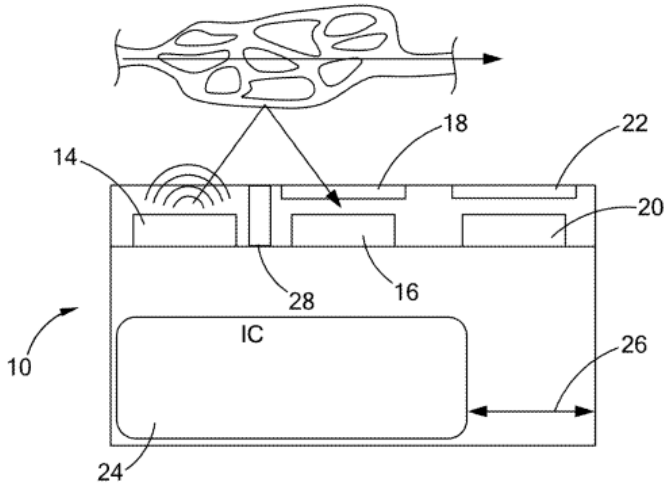
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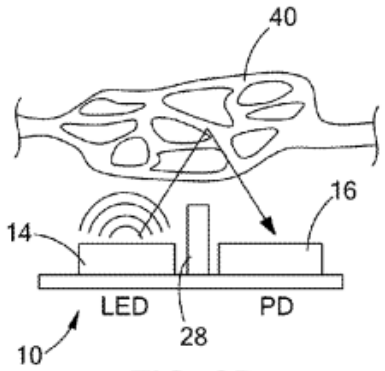
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	 FIG. 17 Basu at Fig. 17. It is known that certain factors may render pulse oximetry unreliable because the presence of other components (e.g. methemoglobin or carboxyhemoglobin) in the blood may mimic the absorption of oxyhemoglobin at the IR LED frequency so that the reading is falsified. Such errors can be minimized by adding a third LED emitting light of a wavelength at which the component shows a different behavior than oxyhemoglobin and reduced hemoglobin. FIG. 15 shows an arrangement of the three LEDs 14, 14′, and 15, positioned on three sides of a photo detector in the form of photodiode 50. An optical barrier 28 separates the photo detector from all three LEDs 14, 14′, and 15. The three LEDs 14, 14′, and 15 may all emit different wavelengths. LEDs 15, and 14, for example, may emit light in the red and IR spectrum, respectively, while LED 14′ may emit light at a wavelength at which the presence of falsifying components can be detected. The photo detector 50 includes photodiodes sensitive to all three wavelengths. Basu at [0109].

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b] the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Basu discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at Abstract. Intensity control: To maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector. In the OPS 10, the LED intensity and modulation frequencies are programmable through the serial interface. In the case of the Vishay VCNL4000, the intensity is programmable from 10-200 mA in 10 mA increments. Others (like the APDS-9190), include digital interrupts which trigger when the photo detector signal is saturated. Basu at [0058].

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’304 Patent	Basu
	 FIG. 1 Basu at Fig. 1. In yet a further development, a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. For example, if one LED 15 emits red light and a second LED 14 emits light in the near infrared, a pulse oximetry sensor can be realized with a very small size. Basu at [0093]. In summary, OPS 10 have traditionally been used in robotics and smart phones, but here we show that OPS 10 perform all photoplethysmography functions in a single, 4 mm-by-4 mm package which links directly to a microcontroller via a standard serial interface. Moreover, it provides substantial performance advantages over existing state-of-the-art photoplethysmography sensors, including: i) 10 times lower power consumption (200 μW), ii) 5 times lower cost ($4), iii) 20 times smaller area, and iv) High signal-to-noise ratio (more than about 90), as a result of built-in optical barriers 28, filters, and ambient light cancellation. The versatility of the device can be demonstrated by measuring photoplethysmography data in several anatomical locations. A multi-LED OPS 10 can provide dual wavelength measurements required for pulse oximetry. These unique qualities make OPS 10 an elegant solution for battery-powered, wearable physiological monitors.

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	Basu at [0110]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c] the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Basu discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample.  FIG. 1 Basu at Fig. 1.

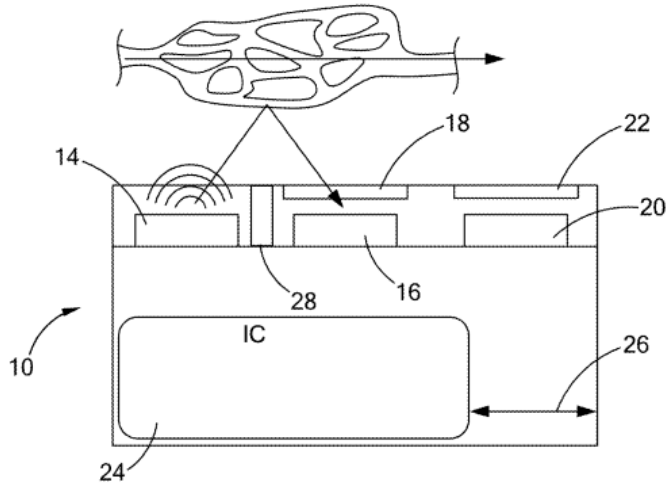
’304 Patent	Basu
	 FIG. 3D Basu at Fig. 3D. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person’s skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at Abstract. In a first approach, this device utilizes electronic optical proximity sensors (OPS) 10 to sense a patient's heart rate. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. Variations of OPS are widely used for non-contact distance measurement in a variety of applications. In smart phones, for example, OPS detect when a phone is placed in a pocket, triggering touch-screen locking. In factory robotics, OPS are used for motion feedback control. In many industrial and consumer applications, OPS serve as touchless switches and

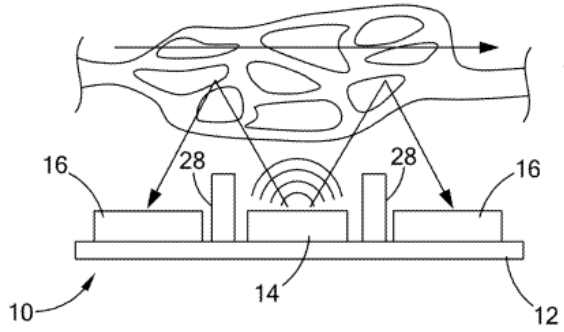
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	gesture sensing devices in personal notebooks, vending machines, sanitary dispensers, lavatories, dimming control, and video games. Basu at [0035]. Heart rate sensing can be performed with the OPS 10 with more than one order of magnitude improvement in power compared to conventional methods. FIG. 5 illustrates pulse shapes for an OPS 10 placed in different locations on a patient's body. The top curve 34 shows a signal obtained from a OPS 10 placed on a fingertip, the second curve 36 represents an OPS 10 signal from an earlobe, and the bottom curve 38 depicts an OPS 10 signal from an upper finger. As is evident, the measurement performed on the earlobe shown in curve 36 exhibits a different shape compared to the measurements 34 and 38 performed on the finger. Basu at [0041]. In a second approach, the time lag along a blood vessel system, for example, along with a change in amplitude and shape of the pulse wave can give information on restrictions and elasticity of the artery, for example due to plaque on the vessel walls. This principle is schematically depicted in FIGS. 6 and 7. An OPS 10 for detecting pulse wave velocity uses a novel sensor setup which detects how fast a pulse wave travels from one side of the sensor to the other side of the sensor (FIGS. 6A and 7). This approach can be robust to environmental noise and to drift of the sensor. Pulse wave velocity can be correlated with blood pressure. The device works in the near infrared (˜950 nm) range. By putting two generally identical photodiodes 16 in two different locations on a circuit board 12 symmetrically on opposite sides of an IR LED 14, the time it takes for a pulse wave to move through the vessel can be measured as shown in the diagram of FIG. 6B. The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected. The reflected signal is sensed by each of the photodiodes 16. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7. Basu at [0041].

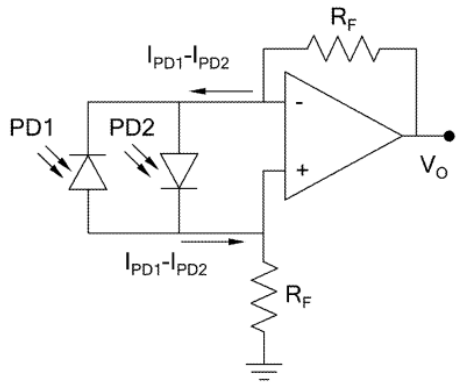
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	FIGS. 3D and 1 illustrate the general working mechanism. The OPS 10 is placed in direct contact with the skin, near a capillary bed 40. Ideal locations include the fingertip, earlobe, or forehead. A protective overlay (not shown in this figure) can be added if desired. The IR LED 14 emits light into the tissue, where it experiences diffuse reflection from the tissue and capillary bed 40. This establishes a baseline reflectance signal at the IR photodiode 16. When a pressure wave propagates through the capillary bed 40, the signal falls slightly (0.5-5%) due to increased light scattering. The change is detected by an amplification and signal processing circuitry in the IC 24 embedded in the OPS 10. In the case of an earlobe or fingertip sensor, a metal backing can be placed on the opposite side of the earlobe or fingertip to improve the reflectance signal. In some embodiments, the metal backing may be provided by the battery 32. Basu at [0045]. The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected. The reflected signal is sensed by each of the photodiodes 16. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7. Basu at [0042] In yet a further development, a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. For example, if one LED 15 emits red light and a second LED 14 emits light in the near infrared, a pulse oximetry sensor can be realized with a very small size. FIG. 14 illustrates how one red LED 15 and one IR LED 14 are arranged on opposite sides of a photo detector 50 that includes photodiodes 16 and 20 sensitive to different spectral ranges, here red for photodiode 20 and near IR for photodiode 16. Each of the LEDs 14 and 15 is separated from the photo detector by an optical barrier 28. The optical barriers 28 do not touch the transparent cover 29 that separates the LEDS 14 and 15, the optical barriers 28, and the photo detector 50 from the human skin because a direct contact between the optical barrier 28 and the cover 29 might result in a bad signal quality. The height of the optical barriers 28 may be derived from empirical measurements until an optimum configuration is found. The

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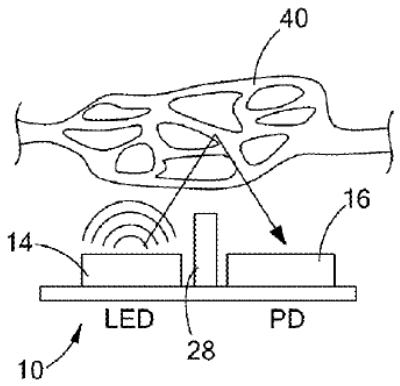
’304 Patent	Basu
	arrangement of FIG. 14 further shows copper barriers 60 embedded in circuit board 12′ extending from underneath each of the LEDs 14 and 15 to a location underneath the adjacent optical barrier 28, respectively, to avoid a light leakage through the circuit board 12′ from the LEDs 14 and 15 to the photodiodes 16 and 20. Basu at [0093] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d] the wearable measurement device further comprising a receiver configured to:	Basu discloses or renders obvious the wearable measurement device further comprising a receiver. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person’s skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract]. According to a first aspect of the invention, an optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an

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	analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. Basu at [0007]. FIG. 6A: A schematic of a proposed sensor system for blood pressure monitoring with two photo detectors and two optical barriers. Basu at [0019]. The OPS 10 further includes an IR photodiode 16, a visible light blocking filter 18, an optical barrier 28. An optional second photodiode 20, sensitive to visible light, may serve as an ambient lights sensor (ALS), useful for ambient noise cancellation. Basu at [0038].  FIG. 1 Basu at Fig. 1.

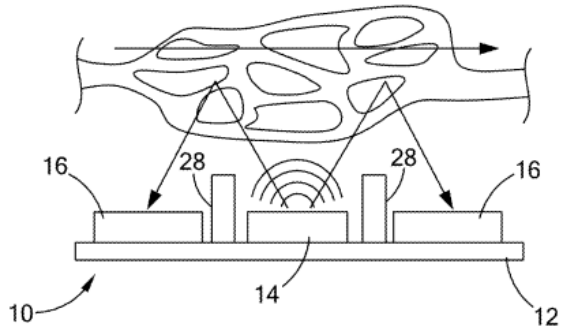
’304 Patent	Basu
	An OPS 10 for detecting pulse wave velocity uses a novel sensor setup which detects how fast a pulse wave travels from one side of the sensor to the other side of the sensor (FIGS. 6A and 7). This approach can be robust to environmental noise and to drift of the sensor. Pulse wave velocity can be correlated with blood pressure. The device works in the near infrared (˜950 nm) range. By putting two generally identical photodiodes 16 in two different locations on a circuit board 12 symmetrically on opposite sides of an IR LED 14, the time it takes for a pulse wave to move through the vessel can be measured as shown in the diagram of FIG. 6B. The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected. The reflected signal is sensed by each of the photodiodes 16. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7. Basu at [0042].  FIG. 6A Basu at Fig. 6.

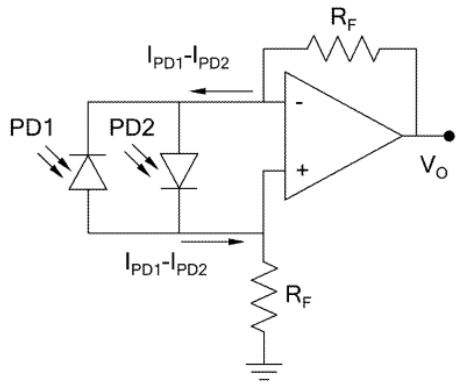
’304 Patent	Basu
	 FIG. 7 Basu at Fig. 7. FIGS. 3D and 1 illustrate the general working mechanism. The OPS 10 is placed in direct contact with the skin, near a capillary bed 40. Ideal locations include the fingertip, earlobe, or forehead. A protective overlay (not shown in this figure) can be added if desired. The IR LED 14 emits light into the tissue, where it experiences diffuse reflection from the tissue and capillary bed 40. This establishes a baseline reflectance signal at the IR photodiode 16. When a pressure wave propagates through the capillary bed 40, the signal falls slightly (0.5-5%) due to increased light scattering. The change is detected by an amplification and signal processing circuitry in the IC 24 embedded in the OPS 10. In the case of an earlobe or fingertip sensor, a metal backing can be placed on the opposite side of the earlobe or fingertip to improve the reflectance signal. In some embodiments, the metal backing may be provided by the battery 32. Basu at [0045].

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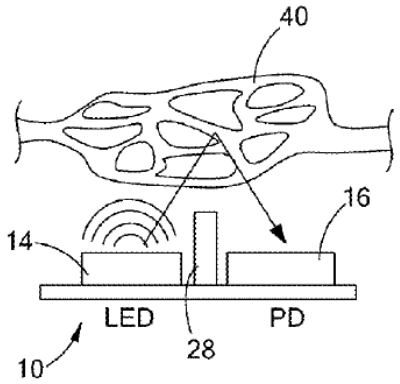
’304 Patent	Basu
	 FIG. 3D Basu at Fig. 3D. 1. An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and a wearable carrier accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin. Basu at Claim 1. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e] receive and process at least a portion of the analysis output beam reflected or transmitted from the sample,	Basu discloses or renders obvious the wearable measurement device further comprising the receiver configured to: receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. An OPS 10 for detecting pulse wave velocity uses a novel sensor setup which detects how fast a pulse wave travels from one side of the sensor to the other side of the sensor (FIGS. 6A and 7). This approach can be robust to environmental noise and to drift of the sensor. Pulse wave velocity can be correlated with blood pressure. The device works in the near infrared (˜950 nm) range. By putting two generally identical photodiodes 16 in two different locations on a circuit board 12 symmetrically on opposite sides of an IR LED 14, the time it takes for a pulse wave to move through the vessel can be measured as shown in the diagram of FIG. 6B. The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected. The reflected signal is sensed by each of the photodiodes 16. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7. Basu at [0042].  FIG. 6A Basu at Fig. 6A.

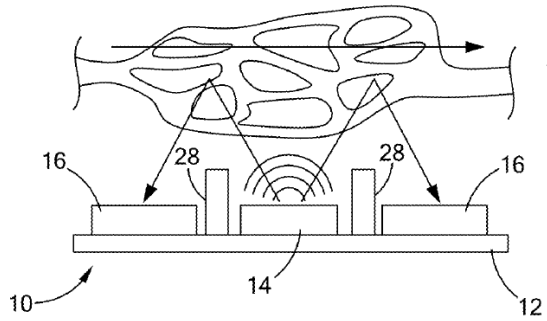
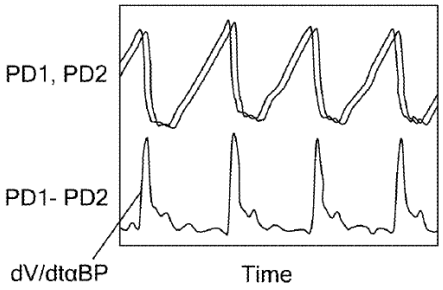
’304 Patent	Basu
	 FIG. 7 Basu at Fig. 7. 3. The optical proximity sensor of claim 1, further comprising an optical barrier between the first IR LED and the first IR photo detector, the optical barrier blocking direct light rays from the first IR LED to the first IR photo detector and permitting reflected light rays to reach the at least one photo detector. Basu at Claim 3. FIGS. 3D and 1 illustrate the general working mechanism. The OPS 10 is placed in direct contact with the skin, near a capillary bed 40. Ideal locations include the fingertip, earlobe, or forehead. A protective overlay (not shown in this figure) can be added if desired. The IR LED 14 emits light into the tissue, where it experiences diffuse reflection from the tissue and capillary bed 40. This establishes a baseline reflectance signal at the IR photodiode 16. When a pressure wave propagates through the capillary bed 40, the signal falls slightly (0.5-5%) due to increased light scattering. The change is detected by an amplification and signal processing circuitry in the IC 24 embedded in the OPS 10. In the case of an earlobe or fingertip sensor, a metal backing can be placed on the opposite side of the earlobe or fingertip to improve the reflectance signal. In some embodiments, the metal backing may be provided by the battery 32. Basu at [0045].

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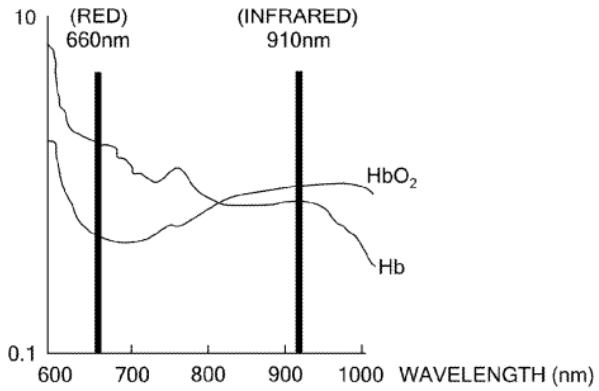
’304 Patent	Basu
	 FIG. 3D Basu at Fig. 3D. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f] generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Basu discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. The present invention relates to a device, a system, and a method for vascular health monitoring of a person. More particularly, the invention relates to a sensor suitable for remote patient monitoring. Basu at [0002].

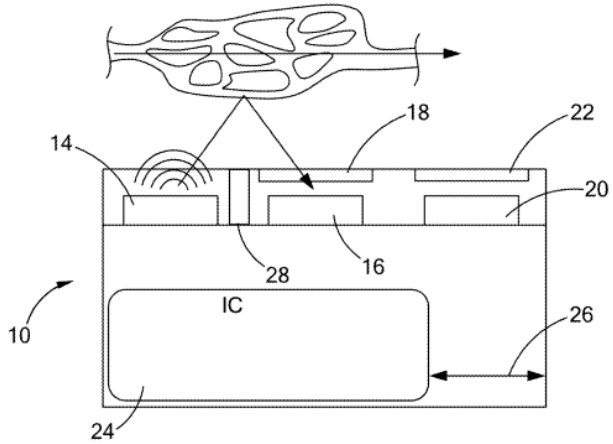
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	This invention includes new technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor. The blood pressure may be indirectly measured using pulse wave velocity by placing several sensors in different locations along an artery. In this manner, vascular conditions can be detected, such as restricted blood flow. Basu at [0034]. In a first approach, this device utilizes electronic optical proximity sensors (OPS) 10 to sense a patient's heart rate. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. Variations of OPS are widely used for non-contact distance measurement in a variety of applications. In smart phones, for example, OPS detect when a phone is placed in a pocket, triggering touch-screen locking. In factory robotics, OPS are used for motion feedback control. In many industrial and consumer applications, OPS serve as touchless switches and gesture sensing devices in personal notebooks, vending machines, sanitary dispensers, lavatories, dimming control, and video games. Basu at [0035]. In a second approach, the time lag along a blood vessel system, for example, along with a change in amplitude and shape of the pulse wave can give information on restrictions and elasticity of the artery, for example due to plaque on the vessel walls. This principle is schematically depicted in FIGS. 6 and 7. An OPS 10 for detecting pulse wave velocity uses a novel sensor setup which detects how fast a pulse wave travels from one side of the sensor to the other side of the sensor (FIGS. 6A and 7). This approach can be robust to environmental noise and to drift of the sensor. Pulse wave velocity can be correlated with blood pressure. The device works in the near infrared (˜950 nm) range. By putting two generally identical photodiodes 16 in two different locations on a circuit board 12 symmetrically on opposite sides of an IR LED 14, the time it takes for a pulse wave to move through the vessel can be measured as shown in the diagram of FIG. 6B. The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected. The reflected signal is sensed by each of the photodiodes 16. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7.

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	Basu at [0042].  FIG. 6A  FIG. 6B Basu at Fig. 6. Pulse oximetry measures blood oxygenation (SpO2) by comparing the pulsation indices at two wavelengths with known absorbance characteristics in oxygenated vs. deoxygenated blood. A multi-LED digital OPS 10 can provide multiple photoplethysmography waveforms, each with a different LED, and can therefore obtain radiometric measurements required for pulse oximetry. Basu at [0094].

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	FIG. 18 illustrates the absorption spectra of oxyhemoglobin, i.e. hemoglobin that has been enriched with oxygen and is found in arterial blood, and of reduced hemoglobin, i.e. hemoglobin that does not carry oxygen. Because Oxyhemoglobin is typically found in arteries, pulse oximetry measures the component of the reflected infrared signal that alternates with the pulse of a patient. The red signal, on the other hand, is much more indicative of the reduced hemoglobin, which is more prevalent in veins and should thus not show a strong pulse. The red LED 15 thus gives a baseline measurement. Comparing the signals from the two LEDs 14 and 15 allows one to measure blood oxygenation, also referred to as SPO2, or oxygen partial pressure. Basu at [0100].  FIG. 18 Basu at Fig. 18. 29. The assembly of claim 27 configured to perform blood oxygenation measurements. Basu at Claim 29. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g] synchronize to the light source,	Basu discloses or renders obvious the receiver configured to synchronize to the light source. As, for example, shown in FIG. 1, An OPS 10 includes an infrared (IR) light emitter, such as an IR LED 14, and an integrated circuit (IC) 24 providing LED drivers modulating the infrared light emitter at a fixed or varying frequency. The drivers may also operate in a burst or low duty cycle operation where the measurement is performed quickly, and then the IR emitter is shut off to conserve power. The OPS 10 includes mixed signal circuits for amplification, signal conditioning, and digitization, i.e. analog-digital conversion, of the detected radiation. During frequency modulation, the LED 14 is pulsed at a predetermined and unique, fixed or variable, frequency. In return the detection circuitry is operated with a digital lock-in technique to detect and select the photodiode signal at the same frequency and phase as the operation of the LED driver. uses a digital lock in technique to select the photodiode signal which is at the same frequency and phase as the signal driving the LED. Basu at [0036].  FIG. 1 Basu at Fig. 1.

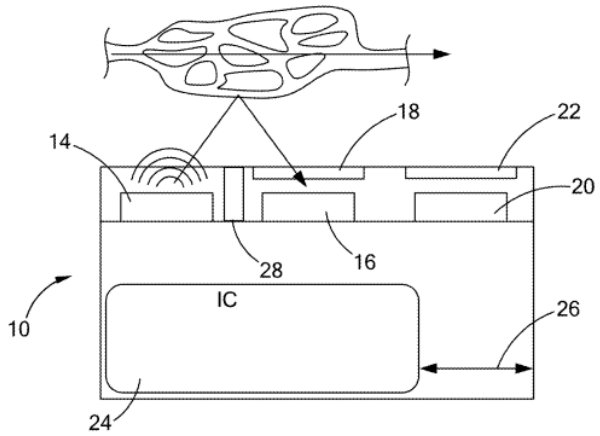
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	The influx of ambient light can be measured during OFF phases of the LED 14. The ambient light component can then be subtracted from the photo detector signal during ON phases to provide a sensitivity offset for proper calibration. This technique being similar in concept to lock-in detection or to electronic noise cancellation, it improves the signal to noise ratio and reduces the impact of noise and ambient light. Basu at [0037]. Electronic noise and offset reduction: The second function of the bandpass filter in photoplethysmography sensors is to remove high frequency noise, including 60/120 Hz noise from ambient light sources. While a 0.5-5 Hz filter can usually remove such noise, it limits the bandwidth of the photoplethysmography sensor, which makes it difficult to resolve some time dependent features of the pressure pulse. An OPS 10 uses electronic modulation to cancel noise and ambient light. The LED 14 is modulated at 1 KHz frequency or higher. The received PD signal oscillates at the same frequency, and the on-chip signal processing utilizes a bandpass or lock-in filtering scheme to remove all the other signal components. This technique effectively eliminates both high and low frequency noise without limiting the bandwidth. It also diminishes the impact of sunlight, which occurs as direct current (DC). Finally, offset can be reduced if a glass overlay (not shown) is placed between the sensor and the skin. An ambient light sensor (ALS) in the form of a visible-light photodiode 20 can also be used as a reference for additional ambient light cancellation. Basu at [0055]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h] capture light while the semiconductor sources are	Basu discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal.

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off and convert the captured light into a first signal,	The influx of ambient light can be measured during OFF phases of the LED 14. The ambient light component can then be subtracted from the photo detector signal during ON phases to provide a sensitivity offset for proper calibration. This technique being similar in concept to lock-in detection or to electronic noise cancellation, it improves the signal to noise ratio and reduces the impact of noise and ambient light. Basu at [0037]. The OPS 10 further includes an IR photodiode 16, a visible light blocking filter 18, an optical barrier 28. An optional second photodiode 20, sensitive to visible light, may serve as an ambient lights sensor (ALS), useful for ambient noise cancellation. Basu at [0038]. Electronic noise and offset reduction: The second function of the bandpass filter in photoplethysmography sensors is to remove high frequency noise, including 60/120 Hz noise from ambient light sources. While a 0.5-5 Hz filter can usually remove such noise, it limits the bandwidth of the photoplethysmography sensor, which makes it difficult to resolve some time dependent features of the pressure pulse. An OPS 10 uses electronic modulation to cancel noise and ambient light. The LED 14 is modulated at 1 KHz frequency or higher. The received PD signal oscillates at the same frequency, and the on-chip signal processing utilizes a bandpass or lock-in filtering scheme to remove all the other signal components. This technique effectively eliminates both high and low frequency noise without limiting the bandwidth. It also diminishes the impact of sunlight, which occurs as direct current (DC). Finally, offset can be reduced if a glass overlay (not shown) is placed between the sensor and the skin. An ambient light sensor (ALS) in the form of a visible-light photodiode 20 can also be used as a reference for additional ambient light cancellation. Basu at [0055]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would

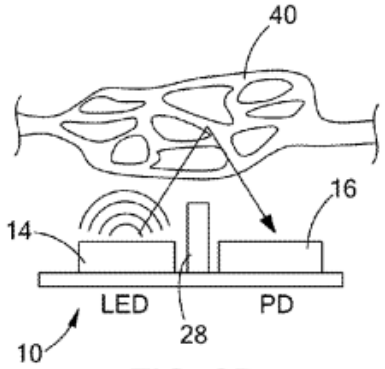
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’304 Patent	Basu
	have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i] capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Basu discloses or renders obvious the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person’s skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at Abstract. As, for example, shown in FIG. 1, An OPS 10 includes an infrared (IR) light emitter, such as an IR LED 14, and an integrated circuit (IC) 24 providing LED drivers modulating the infrared light emitter at a fixed or varying frequency. The drivers may also operate in a burst or low duty cycle operation where the measurement is performed quickly, and then the IR emitter is shut off to conserve power. The OPS 10 includes mixed signal circuits for amplification, signal conditioning, and digitization, i.e. analog-digital conversion, of the detected radiation. During frequency modulation, the LED 14 is pulsed at a predetermined and unique, fixed or variable, frequency. In return the detection circuitry is operated with a digital lock-in technique to detect and select the photodiode signal at the same frequency and phase as the operation of the LED driver. uses a digital lock in technique to select the photodiode signal which is at the same frequency and phase as the signal driving the LED. Basu at [0036]

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	 FIG. 1 Basu at Fig. 1. The influx of ambient light can be measured during OFF phases of the LED 14. The ambient light component can then be subtracted from the photo detector signal during ON phases to provide a sensitivity offset for proper calibration. This technique being similar in concept to lock-in detection or to electronic noise cancellation, it improves the signal to noise ratio and reduces the impact of noise and ambient light. Basu at [0037]. FIGS. 3D and 1 illustrate the general working mechanism. The OPS 10 is placed in direct contact with the skin, near a capillary bed 40. Ideal locations include the fingertip, earlobe, or forehead. A protective overlay (not shown in this figure) can be added if desired. The IR LED 14 emits light into the tissue, where it experiences diffuse reflection from the tissue and capillary bed 40. This establishes a baseline reflectance signal at the IR photodiode 16. When a pressure wave propagates through the capillary bed 40, the signal falls slightly (0.5-5%) due to increased light scattering. The change is detected by an amplification and signal processing circuitry in the IC 24 embedded in the OPS 10. In the case of an earlobe or fingertip sensor, a metal backing can be placed on the opposite side of the earlobe or fingertip to improve the reflectance signal. In some embodiments, the metal backing may be provided by the battery 32.

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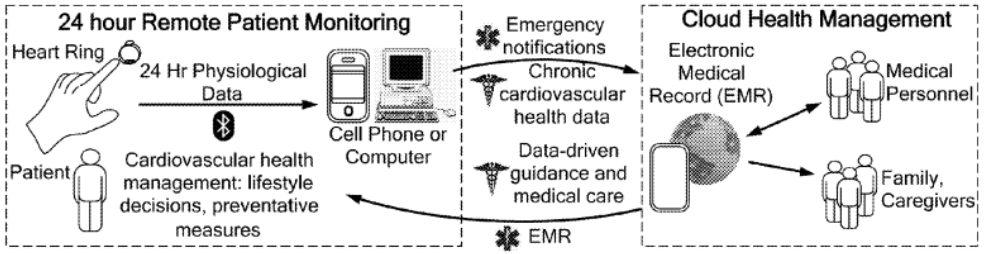
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	Basu at [0045].  FIG. 3D Basu at Fig. 3D The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected. The reflected signal is sensed by each of the photodiodes 16. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7. Basu at [0042]. 1. An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and

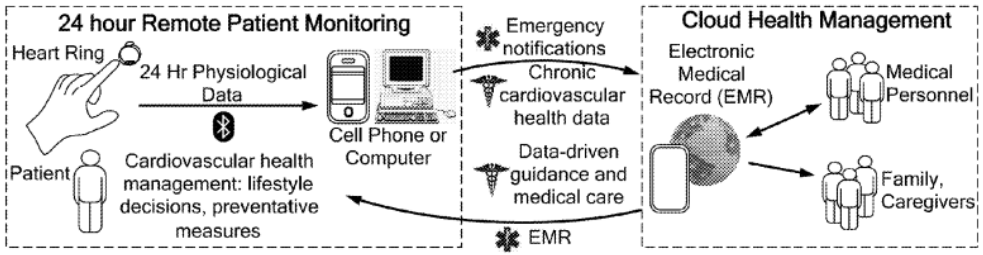
’304 Patent	Basu
	a wearable carrier accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin. Basu at Claim 1. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j] wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Basu discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. The influx of ambient light can be measured during OFF phases of the LED 14. The ambient light component can then be subtracted from the photo detector signal during ON phases to provide a sensitivity offset for proper calibration. This technique being similar in concept to lock-in detection or to electronic noise cancellation, it improves the signal to noise ratio and reduces the impact of noise and ambient light. Basu at [0037]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless	Basu discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a

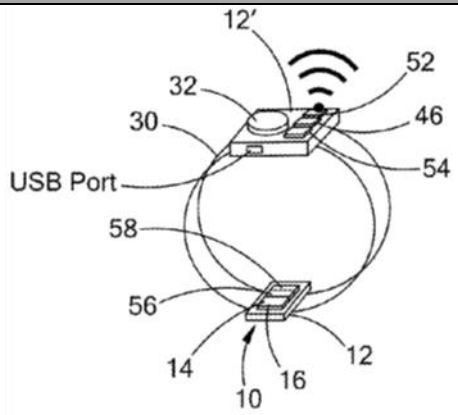
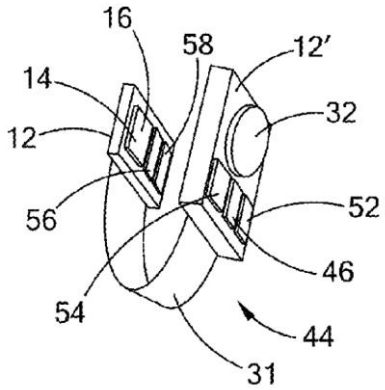
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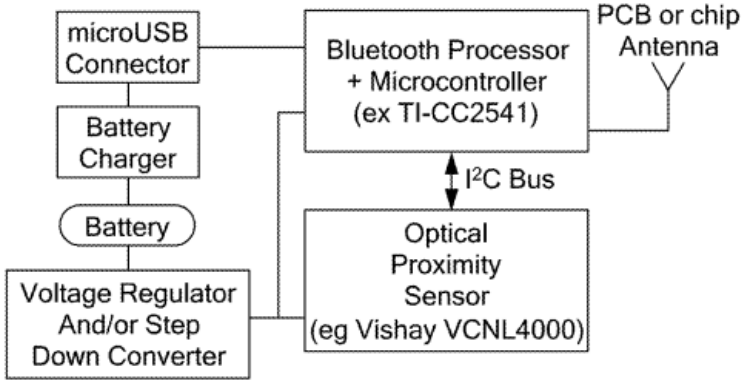
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receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. Multiple photoplethysmography measurements were obtained by placing the OPS 10 in firm contact with the skin at multiple locations as previously described in connection with FIG. 5. In the earlobe measurements, a metal cap was placed on the opposite side to improve the reflectance measurement. The photoplethysmography data were recorded using a Silicon Labs microcontroller directly connected to a laptop via USB. Basu at [0048]. These technologies are integrated with a Bluetooth module 46 or another suitable wireless technology and with rechargeable batteries 32 in a small package, making the sensor assembly wireless and comfortably wearable throughout the day. OPS 10 and a low power Bluetooth transmitter can be integrated into the underside of a ring 44 or placed on a separate board 12′ along with the battery 32. Beside Bluetooth technology and Bluetooth Low Energy technology, any other low-power transmission protocol is suitable for communication with a computer for evaluation. Basu at [0062]. As further shown in FIG. 11, a “cloud-based” RPM infrastructure can actively manage cardiovascular health. Using OPS technology, cardiovascular parameters can be monitored on a 24-hour ambulatory basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record. These data will then be available to the patient's physician, providing an effective tool for quantitative assessment, without bias from “white-coat” alteration, thus providing a means for evidence-based medical management. In emergency situations, notifications can be sent to a medical response team and family members. An RPM-driven model will dramatically reduce the cost of chronic cardiovascular care through earlier detection of impending decompensation, white also improving health outcomes by motivating the patient to actively monitor health and take preventative measures. Basu at [0064].

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	 FIG. 11 Basu at Fig. 11. Having demonstrated that the sensor technology is fairly robust, a wireless ring 44 which combines the sensor with a Bluetooth, Bluetooth Low Energy (BLE), or other wireless transmitter linked to an application running on the user's cell phone. Basu at [0066]. Due to the low price, other potential markets may include consumer fitness (as replacement for straps, watches) and the mobile phone industry (as Bluetooth accessory). The worldwide market for home health monitoring of was worth about $10 billion in 2010. Basu at [0078]. In summary, OPS 10 have traditionally been used in robotics and smart phones, but here we show that OPS 10 perform all photoplethysmography functions in a single, 4 mm-by-4 mm package which links directly to a microcontroller via a standard serial interface. Basu at [0110]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would

’304 Patent	Basu
	have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Basu discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.  FIG. 11 Basu at Fig. 11. FIG. 11: A long term concept using RPM for at-risk cardiovascular patients to actively manage their cardiovascular health; Basu at [0025].

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	 FIG. 12 Basu at Fig. 12. FIG. 12: A schematic of an alternative proposed sensor system for heart rate monitoring, with parts drawn approximately to scale; Basu at [0026].  FIG. 13

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	Basu at Fig. 13. FIG. 13: A schematic of a further alternative proposed sensor system for heart rate monitoring, with parts drawn approximately to scale; Basu at [0027]. An IR blocking filter 22 is arranged to protect the photodiode 20 from pollution from scattered IR radiation. Integrated digital OPS 10, available recently, are highly integrated devices which include all the above components in a small, surface mount package, typically a few millimeters in size. These sensors also provide a bidirectional serial interface 26 to a microcontroller for sending data and configuring the device. Instead of or in addition to the serial interface 26, a wireless transmitter may be incorporated in the device, for example in the form of a Bluetooth® module 46, as indicated in FIG. 2. Basu at [0039].  FIG. 2 Basu at Fig. 2. By placing the LED 14 and photodiode 16 close together, the sensitivity improves, and the optimal sensing distance also becomes smaller. Typical optical proximity sensors have an optical sensing of 1-5

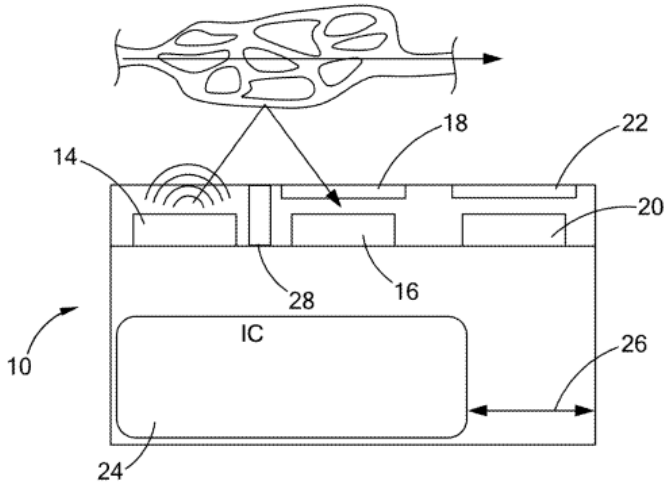
’304 Patent	Basu
	mm, which is the distance between the sensor and the blood vessel. The optical proximity sensor is compact, cheap, small, and integrates easily with digital microprocessors. Basu at [0061]. These technologies are integrated with a Bluetooth module 46 or another suitable wireless technology and with rechargeable batteries 32 in a small package, making the sensor assembly wireless and comfortably wearable throughout the day. OPS 10 and a low power Bluetooth transmitter can be integrated into the underside of a ring 44 or placed on a separate board 12′ along with the battery 32. Beside Bluetooth technology and Bluetooth Low Energy technology, any other low-power transmission protocol is suitable for communication with a computer for evaluation. Basu at [0062]. This technology leads to a remarkably small (less than 50 mm2, preferably less than about 25 mm2) and cheap (less than about $20) wireless heart rate sensor. The technology can be integrated into home health monitoring systems where the information is transmitted wirelessly to the patient's physician, hospital, and other caregivers, as schematically indicated in FIG. 11. It can also be incorporated into the patient's electronic medical record. The miniature, low cost wearable heart rate sensor has applications in various fields, such as remote patient monitoring (RPM). Basu at [0063]. As further shown in FIG. 11, a “cloud-based” RPM infrastructure can actively manage cardiovascular health. Using OPS technology, cardiovascular parameters can be monitored on a 24-hour ambulatory basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record. These data will then be available to the patient's physician, providing an effective tool for quantitative assessment, without bias from “white-coat” alteration, thus providing a means for evidence-based medical management. In emergency situations, notifications can be sent to a medical response team and family members. An RPM-driven model will dramatically reduce the cost of chronic cardiovascular care through earlier detection of impending decompensation, white also improving health outcomes by motivating the patient to actively monitor health and take preventative measures. Basu at [0064].

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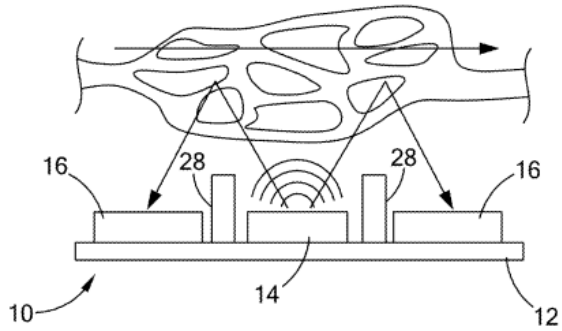
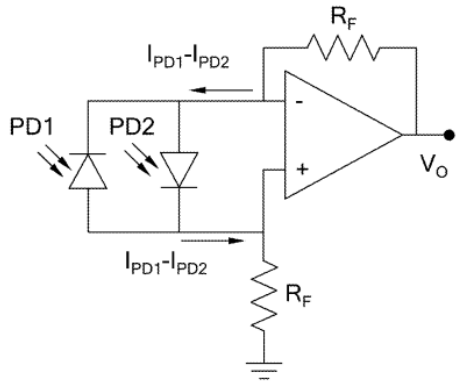
’304 Patent	Basu
	The technology is suited to be deployed in a cloud-based health monitoring and mentoring framework which integrates remote patient monitoring (RPM) with an online community involving medical caregivers and a social network of the patient's peers. This framework may even be used to treat psychosocial disorders. Basu at [0081] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Basu discloses or renders obvious the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein	Basu discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set.

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the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Basu discloses or renders obvious the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Basu discloses or renders obvious the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. Intensity control: To maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector. In the OPS 10, the LED intensity and modulation frequencies are programmable through the serial interface. In the case of the Vishay VCNL4000, the intensity is programmable from 10-200 mA in 10 mA increments. Others (like the APDS-9190), include digital interrupts which trigger when the photo detector signal is saturated. Basu at [0058]

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	 FIG. 1 Basu at Fig. 1. In summary, OPS 10 have traditionally been used in robotics and smart phones, but here we show that OPS 10 perform all photoplethysmography functions in a single, 4 mm-by-4 mm package which links directly to a microcontroller via a standard serial interface. Moreover, it provides substantial performance advantages over existing state-of-the-art photoplethysmography sensors, including: i) 10 times lower power consumption (200 μW), ii) 5 times lower cost ($4), iii) 20 times smaller area, and iv) High signal-to-noise ratio (more than about 90), as a result of built-in optical barriers 28, filters, and ambient light cancellation. The versatility of the device can be demonstrated by measuring photoplethysmography data in several anatomical locations. A multi-LED OPS 10 can provide dual wavelength measurements required for pulse oximetry. These unique qualities make OPS 10 an elegant solution for battery-powered, wearable physiological monitors. Basu at [0110]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

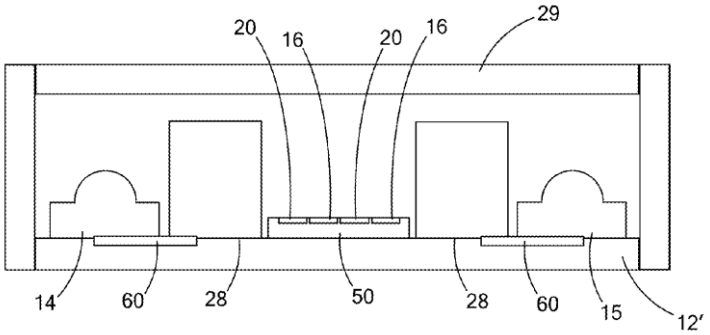
’304 Patent	Basu
	incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Basu discloses or renders obvious the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11, 11[a], 11[e] above. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract] According to further embodiments of the invention, a single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Basu at [0008] An OPS 10 for detecting pulse wave velocity uses a novel sensor setup which detects how fast a pulse wave travels from one side of the sensor to the other side of the sensor (FIGS. 6A and 7). This approach can be robust to environmental noise and to drift of the sensor. Pulse wave velocity can be correlated with blood pressure. The device works in the near infrared (˜950 nm) range. By putting two generally identical photodiodes 16 in two different locations on a circuit board 12 symmetrically on opposite sides

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	of an IR LED 14, the time it takes for a pulse wave to move through the vessel can be measured as shown in the diagram of FIG. 6B. The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected. The reflected signal is sensed by each of the photodiodes 16. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7. Basu at [0042]  FIG. 6A Basu at Fig. 6.  FIG. 7

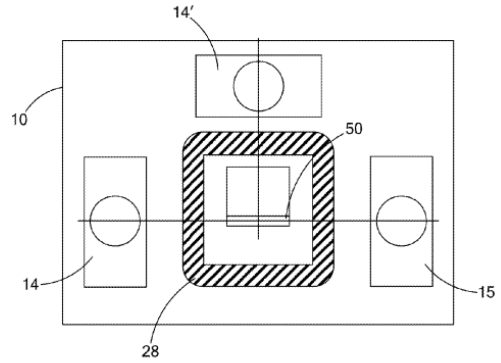
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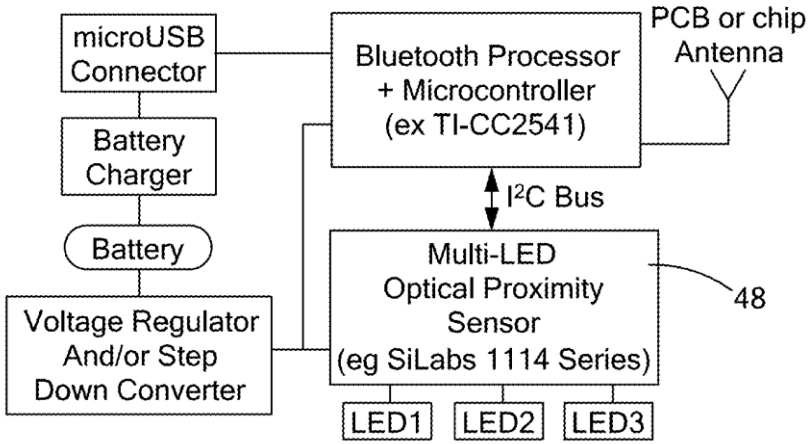
’304 Patent	Basu
	Basu at Fig. 7. The OPS 10 was placed with fixed pressure in multiple locations, including the fingertip, an earlobe, and upper finger (to simulate a ring sensor). A metal backing was added to the OPS 10 on the opposite side of the earlobe to improve the reflectance signal. One example of an OPS formed as an ear clip 44 is shown in FIG. 13. Those elements that are placed on the board 12′ of the battery 32 in FIG. 12 are placed on the outside of the ear clip 44 and face away from the person's head, shown in FIG. 13 on the right side. The battery 32 may additionally be arranged to provide a reflective surface for the light emitted by the LED 14 toward the photodiode 16. A button cell battery is well suited for this purpose due to its planar metallic end facing the LED 14 and the photodiode 16. The OPS 10 is placed on the inside of the ear clip 44, facing the earlobe from the side of the person's head. It is evident, that the locations may also be reversed without leaving the scope of the present invention. Basu at [0088]. In yet a further development, a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. For example, if one LED 15 emits red light and a second LED 14 emits light in the near infrared, a pulse oximetry sensor can be realized with a very small size. FIG. 14 illustrates how one red LED 15 and one IR LED 14 are arranged on opposite sides of a photo detector 50 that includes photodiodes 16 and 20 sensitive to different spectral ranges, here red for photodiode 20 and near IR for photodiode 16. Each of the LEDs 14 and 15 is separated from the photo detector by an optical barrier 28. The optical barriers 28 do not touch the transparent cover 29 that separates the LEDS 14 and 15, the optical barriers 28, and the photo detector 50 from the human skin because a direct contact between the optical barrier 28 and the cover 29 might result in a bad signal quality. The height of the optical barriers 28 may be derived from empirical measurements until an optimum configuration is found. The arrangement of FIG. 14 further shows copper barriers 60 embedded in circuit board 12′ extending from underneath each of the LEDs 14 and 15 to a location underneath the adjacent optical barrier 28, respectively, to avoid a light leakage through the circuit board 12′ from the LEDs 14 and 15 to the photodiodes 16 and 20. Basu at [0093]

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	The use of a multi-LED OPS 10 for pulse oximetry is shown schematically in FIGS. 14, 15, 16, and 17. The multi-LED OPS 10 detects signals from multiple discrete LEDs 14 and 15, and optionally 14′, which can be multiplexed on a single photo detector 50 equipped with photodiodes 16 of infrared detection and photodiodes 20 for detecting red light. A typical sensor shown in 17 includes the photo detector 50, 2 or more LED drivers, and electronics for signal conditioning and multiplexing the data channels on a common circuit board 48. The LEDs 14 and 15, and optionally 14′, are added separately to the circuit board, along with an optical barrier 28 to reduce leakage if desired as shown in 15. While this increases the chip count, it does allow flexibility in positioning the LEDs 14 and 15, and 14′ for either transmittance or reflectance mode, and in choosing the appropriate wavelengths. Basu at [0096]  FIG. 14 Basu at Fig. 14

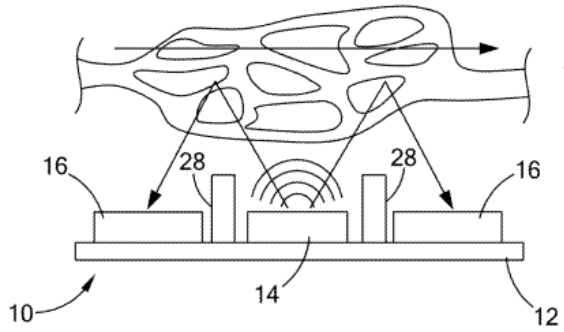
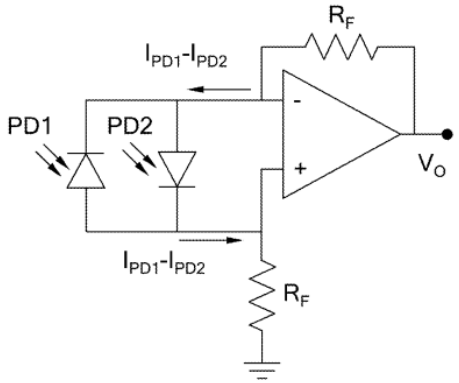
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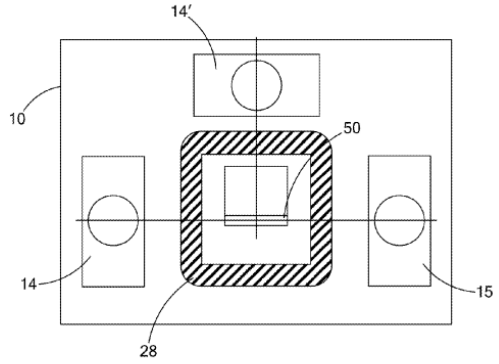
’304 Patent	Basu
	 FIG. 15 Basu at Fig. 15. Thus, suitable wavelengths for pulse oximetry are in the range of about 600 nm to 700 nm for the red LED 15, preferably between about 650 nm and 670 nm, and about 850 nm to 950 nm, preferably about 900 nm to 940 nm for the near infrared LED 14. Notably, a deviation from the preferred wavelengths is feasible and may make the sensor 10 cheaper due to the availability of commercially produced LEDs 14 and 15. The two LEDs 14 and 15 may be pulsed. Optionally, the two LEDs 14 and 15 may be pulsed at different frequencies through frequency multiplexing. Alternatively. The LEDs 14 and 15 may be pulsed in an alternating mode through time multiplexing. Pulsing the LEDs 14 and 15 promotes an easy distinction of the two signals where both signals are received by the same photo detector. Basu at [0099] For pulse oximetry, the Silicon Labs Si1143 was used, a triple-LED digital OPS 10, as is schematically indicated in FIG. 17. The chip 48 includes a photodiode 50 with FWHM spectral bandwidth of 600-1000 nm, 3 LED drivers, and a signal conditioning logic on the embedded IC. Unlike the VCNL4000, the Si1143 does not include the LEDs on the chip 48 itself. Surface mount IR LEDs 14, 14′, and 15 (OSRAM) were placed within 3 mm on either side of the photodiode. The half angle of the chosen LEDs 14, 14′, and 15 is 22 degrees, which limits the light leakage. Each LED current can be set between 5.6 and 360 mA. The Si1143 uses time multiplexing to measure the reflectance from two or three LEDs on a single photo detector. Like the VCNL4000, it uses short LED pulses (25 μsec), which reduces the power consumption of the system. With three 100 mA LEDs 14, 14′, and 15 operating at a 100 Hz data

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	rate, the power consumption is still less than about 800 μW. The Si1143 also includes an I2 C bus interface 26 for sensor configuration and reading sensor data. The ambient light sensor 20 included on the chip 48 can be used for sensing whether the chip 48 has been placed in contact with the skin. Basu at [0104] While the schematic setup shown in FIG. 17 for operating a pulse oximetry sensor according to the present invention depicts three LEDs 14, 14′, and 15, two LEDs, for example LED 14 and LED 15, are sufficient for performing the required measurements as discussed above. Basu at [0108]  FIG. 17 Basu at Fig. 17

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Basu discloses or renders obvious the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above. An OPS 10 for detecting pulse wave velocity uses a novel sensor setup which detects how fast a pulse wave travels from one side of the sensor to the other side of the sensor (FIGS. 6A and 7). This approach can be robust to environmental noise and to drift of the sensor. Pulse wave velocity can be correlated with blood pressure. The device works in the near infrared (˜950 nm) range. By putting two generally identical photodiodes 16 in two different locations on a circuit board 12 symmetrically on opposite sides of an IR LED 14, the time it takes for a pulse wave to move through the vessel can be measured as shown in the diagram of FIG. 6B. The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected. The reflected signal is sensed by each of the photodiodes 16. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7. Basu at [0042]

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	 FIG. 6A Basu at Fig. 6.  FIG. 7 Basu at Fig. 7. It is known that certain factors may render pulse oximetry unreliable because the presence of other components (e.g. methemoglobin or carboxyhemoglobin) in the blood may mimic the absorption of oxyhemoglobin at the IR LED frequency so that the reading is falsified. Such errors can be minimized by adding a third LED emitting light of a wavelength at which the component shows a different behavior than oxyhemoglobin and reduced hemoglobin. FIG. 15 shows an arrangement of the three LEDs 14, 14′, and 15, positioned on three sides of a photo detector in the form of photodiode 50. An optical barrier 28 separates the photo detector from all three LEDs 14, 14′, and 15. The three LEDs 14, 14′, and 15 may all

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	emit different wavelengths. LEDs 15, and 14, for example, may emit light in the red and IR spectrum, respectively, while LED 14′ may emit light at a wavelength at which the presence of falsifying components can be detected. The photo detector 50 includes photodiodes sensitive to all three wavelengths. Basu at [0109]  FIG. 15 Basu at Fig. 15. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Basu discloses or renders obvious the first arc and the second arc are concentric. *See* claim 15 above.

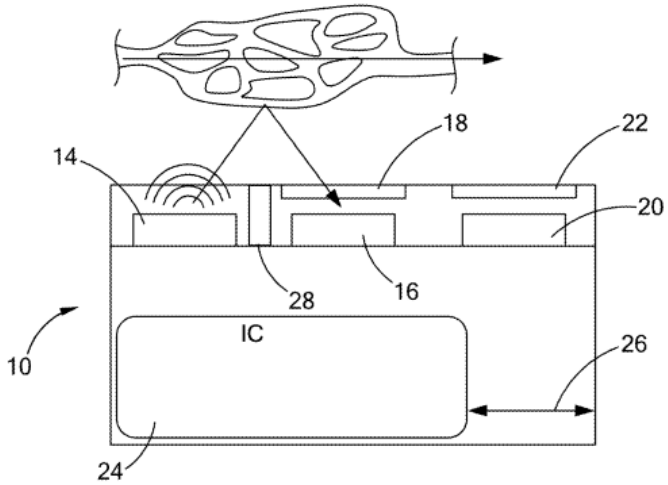
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'304 Patent	**Basu**
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Basu discloses or renders obvious a wearable device for use with a smart phone or tablet, the wearable device. *See* 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,:	Basu discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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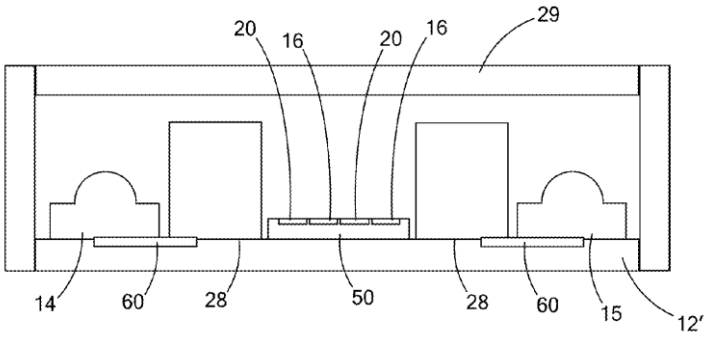
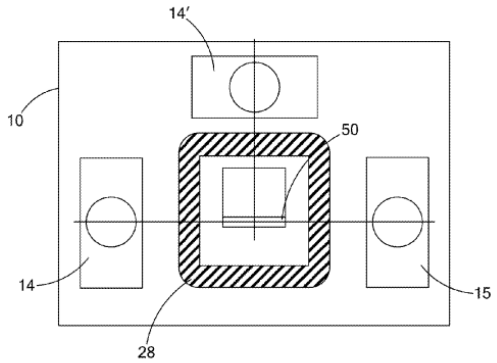
’304 Patent	Basu
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Basu discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract] According to further embodiments of the invention, a single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Basu at [0008] In a first approach, this device utilizes electronic optical proximity sensors (OPS) 10 to sense a patient's heart rate. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. Variations of OPS are widely used for non-contact distance measurement in a variety of applications. In smart phones, for example, OPS detect when a phone is placed in a pocket, triggering touch-screen locking. In factory robotics, OPS are used for motion feedback control. In many industrial and consumer applications, OPS serve as touchless switches and gesture sensing devices in personal notebooks, vending machines, sanitary dispensers, lavatories, dimming control, and video games. Basu at [0035]

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	 FIG. 1 Basu at Fig. 1. As, for example, shown in FIG. 1, An OPS 10 includes an infrared (IR) light emitter, such as an IR LED 14, and an integrated circuit (IC) 24 providing LED drivers modulating the infrared light emitter at a fixed or varying frequency. The drivers may also operate in a burst or low duty cycle operation where the measurement is performed quickly, and then the IR emitter is shut off to conserve power. The OPS 10 includes mixed signal circuits for amplification, signal conditioning, and digitization, i.e. analog-digital conversion, of the detected radiation. During frequency modulation, the LED 14 is pulsed at a predetermined and unique, fixed or variable, frequency. In return the detection circuitry is operated with a digital lock-in technique to detect and select the photodiode signal at the same frequency and phase as the operation of the LED driver. uses a digital lock in technique to select the photodiode signal which is at the same frequency and phase as the signal driving the LED. Basu at [0036] The OPS 10 is generally illustrated in FIG. 1 and includes an embedded 895 nm IR LED 14 and a photodiode 16 with visible light blocking filter 22. The spacing between the LED 14 and photodiode 16 is about 2 mm, resulting in a large reflectance and sensitivity. The LED 14 is embedded in a recessed region which serves as an optical barrier 28 to reduce light leakage. The embedded signal processing IC

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	24 handles LED modulation, current control (10-200 mA in 10 mA steps), photo detector amplification and signal conditioning, ambient light cancellation, 16-bit analog to digital conversion (ADC), and I2C bus communication. The ADC can resolve pulsation indices of 15 ppm. The LED 14 can be modulated at frequencies up to 3.1 MHz (user selectable) for electronic noise cancellation. To reduce power consumption, each measurement is completed in 75 μsec, and the LED 14 is kept off at the remainder of the measurement cycle. This allows one to use a large LED current (100 mA) while consuming less than about 200 μW power at a 100 Hz data rate. The supply voltage range is 2.5-3.6 V, which is well suited for operation from a 3V coin cell rechargeable battery 32. The IR LED 14 is placed on a separate supply to reduce the effects of digital switching noise. The I2C serial interface 26, supported by most microcontrollers, is used to transmit data and to configure the OPS 10. The cost of the component is comparatively low. Notably, the above specification is only one example of an operational OPS. For example, a 12-bit analog-to-digital conversion may be sufficient. Basu at [0047] Electronic noise and offset reduction: The second function of the bandpass filter in photoplethysmography sensors is to remove high frequency noise, including 60/120 Hz noise from ambient light sources. While a 0.5-5 Hz filter can usually remove such noise, it limits the bandwidth of the photoplethysmography sensor, which makes it difficult to resolve some time dependent features of the pressure pulse. An OPS 10 uses electronic modulation to cancel noise and ambient light. The LED 14 is modulated at 1 KHz frequency or higher. The received PD signal oscillates at the same frequency, and the on-chip signal processing utilizes a bandpass or lock-in filtering scheme to remove all the other signal components. This technique effectively eliminates both high and low frequency noise without limiting the bandwidth. It also diminishes the impact of sunlight, which occurs as direct current (DC). Finally, offset can be reduced if a glass overlay (not shown) is placed between the sensor and the skin. An ambient light sensor (ALS) in the form of a visible-light photodiode 20 can also be used as a reference for additional ambient light cancellation. Bsu at [0055] Intensity control: To maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector. In the OPS 10, the LED intensity and modulation frequencies are programmable through the serial interface. In the case of the Vishay

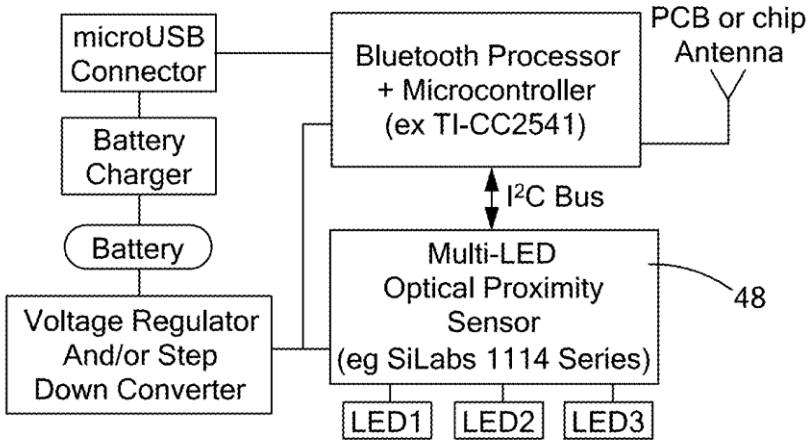
’304 Patent	Basu
	VCNL4000, the intensity is programmable from 10-200 mA in 10 mA increments. Others (like the APDS-9190), include digital interrupts which trigger when the photo detector signal is saturated. Basu at [0058] In yet a further development, a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. For example, if one LED 15 emits red light and a second LED 14 emits light in the near infrared, a pulse oximetry sensor can be realized with a very small size. FIG. 14 illustrates how one red LED 15 and one IR LED 14 are arranged on opposite sides of a photo detector 50 that includes photodiodes 16 and 20 sensitive to different spectral ranges, here red for photodiode 20 and near IR for photodiode 16. Each of the LEDs 14 and 15 is separated from the photo detector by an optical barrier 28. The optical barriers 28 do not touch the transparent cover 29 that separates the LEDS 14 and 15, the optical barriers 28, and the photo detector 50 from the human skin because a direct contact between the optical barrier 28 and the cover 29 might result in a bad signal quality. The height of the optical barriers 28 may be derived from empirical measurements until an optimum configuration is found. The arrangement of FIG. 14 further shows copper barriers 60 embedded in circuit board 12′ extending from underneath each of the LEDs 14 and 15 to a location underneath the adjacent optical barrier 28, respectively, to avoid a light leakage through the circuit board 12′ from the LEDs 14 and 15 to the photodiodes 16 and 20. Basu at [0093] The use of a multi-LED OPS 10 for pulse oximetry is shown schematically in FIGS. 14, 15, 16, and 17. The multi-LED OPS 10 detects signals from multiple discrete LEDs 14 and 15, and optionally 14′, which can be multiplexed on a single photo detector 50 equipped with photodiodes 16 of infrared detection and photodiodes 20 for detecting red light. A typical sensor shown in 17 includes the photo detector 50, 2 or more LED drivers, and electronics for signal conditioning and multiplexing the data channels on a common circuit board 48. The LEDs 14 and 15, and optionally 14′, are added separately to the circuit board, along with an optical barrier 28 to reduce leakage if desired as shown in 15. While this increases the chip count, it does allow flexibility in positioning the LEDs 14 and 15, and 14′ for either transmittance or reflectance mode, and in choosing the appropriate wavelengths.

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	Basu at [0096]  FIG. 14 Basu at Fig. 14  FIG. 15 Basu at Fig. 15. Thus, suitable wavelengths for pulse oximetry are in the range of about 600 nm to 700 nm for the red LED 15, preferably between about 650 nm and 670 nm, and about 850 nm to 950 nm, preferably about 900 nm to 940 nm for the near infrared LED 14. Notably, a deviation from the preferred wavelengths is feasible and may make the sensor 10 cheaper due to the availability of commercially produced LEDs 14

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	and 15. The two LEDs 14 and 15 may be pulsed. Optionally, the two LEDs 14 and 15 may be pulsed at different frequencies through frequency multiplexing. Alternatively. The LEDs 14 and 15 may be pulsed in an alternating mode through time multiplexing. Pulsing the LEDs 14 and 15 promotes an easy distinction of the two signals where both signals are received by the same photo detector. Basu at [0099] For pulse oximetry, the Silicon Labs Si1143 was used, a triple-LED digital OPS 10, as is schematically indicated in FIG. 17. The chip 48 includes a photodiode 50 with FWHM spectral bandwidth of 600-1000 nm, 3 LED drivers, and a signal conditioning logic on the embedded IC. Unlike the VCNL4000, the Si1143 does not include the LEDs on the chip 48 itself. Surface mount IR LEDs 14, 14′, and 15 (OSRAM) were placed within 3 mm on either side of the photodiode. The half angle of the chosen LEDs 14, 14′, and 15 is 22 degrees, which limits the light leakage. Each LED current can be set between 5.6 and 360 mA. The Si1143 uses time multiplexing to measure the reflectance from two or three LEDs on a single photo detector. Like the VCNL4000, it uses short LED pulses (25 μsec), which reduces the power consumption of the system. With three 100 mA LEDs 14, 14′, and 15 operating at a 100 Hz data rate, the power consumption is still less than about 800 μW. The Si1143 also includes an I2 C bus interface 26 for sensor configuration and reading sensor data. The ambient light sensor 20 included on the chip 48 can be used for sensing whether the chip 48 has been placed in contact with the skin. Basu at [0104] While the schematic setup shown in FIG. 17 for operating a pulse oximetry sensor according to the present invention depicts three LEDs 14, 14′, and 15, two LEDs, for example LED 14 and LED 15, are sufficient for performing the required measurements as discussed above. Basu at [0108]

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	 FIG. 17 Basu at Fig. 17 It is known that certain factors may render pulse oximetry unreliable because the presence of other components (e.g. methemoglobin or carboxyhemoglobin) in the blood may mimic the absorption of oxyhemoglobin at the IR LED frequency so that the reading is falsified. Such errors can be minimized by adding a third LED emitting light of a wavelength at which the component shows a different behavior than oxyhemoglobin and reduced hemoglobin. FIG. 15 shows an arrangement of the three LEDs 14, 14′, and 15, positioned on three sides of a photo detector in the form of photodiode 50. An optical barrier 28 separates the photo detector from all three LEDs 14, 14′, and 15. The three LEDs 14, 14′, and 15 may all emit different wavelengths. LEDs 15, and 14, for example, may emit light in the red and IR spectrum, respectively, while LED 14′ may emit light at a wavelength at which the presence of falsifying components can be detected. The photo detector 50 includes photodiodes sensitive to all three wavelengths. Basu at [0109]

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Basu discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light	Basu discloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue. *See* 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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including at least a portion of the input optical beam reflected from the tissue;	incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Basu discloses or renders obvious the receiver configured tosynchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Basu discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* 11[b], 11[h], 11[i], 11[j], 19[a], 19[d] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Basu discloses or renders obvious the measurement device further configured increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[a], 11[b], 19[a].

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Basu discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 11[a], 11[f], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Basu discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link.	Basu discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, and store and display the processed output signal, transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Basu discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claims 19, 13 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc,	Basu discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claims 15, 20 above.

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and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Basu discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claims 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D2

U.S. Pat. No. 10,874,304 in view of U.S. Patent Publication No. 2005/0049468 to Sven-Erik Carlson et al. ("Carlson")

As described in detail below, Carlson (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either alone in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1 and D3-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Carlson. The cited portions of Carlson are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Carlson. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Carlson "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Carlson does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Carlson (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Carlson anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

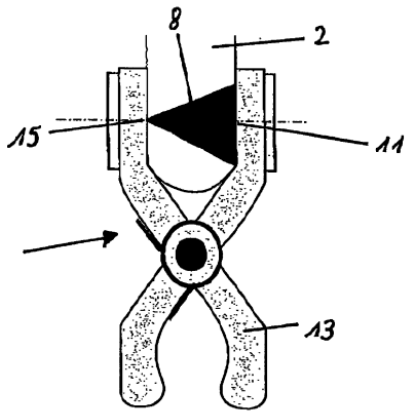
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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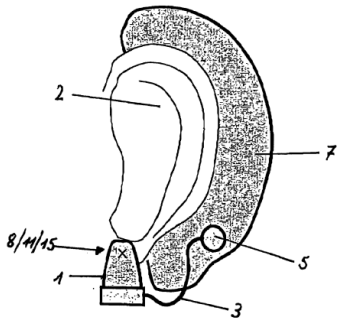
EXHIBIT D2

’304 Patent	Carlson
Claim 11	
11[pre] A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Carlson discloses or renders obvious a measurement system. The invention relates in particular to optical pulsoximetry used for non-invasive measurement of pulsation and oxygen saturation in arterial human or animal blood, and is particularly concerned with increasing the technical performance of pulsoximetry in terms of quality and robustness of the measurement signal versus environmental disturbances and energy consumption. Carlson at [0002]. The posed problem is solved by means of a con figuration/method according to the invention. Proposed is a configuration for monitoring which comprises at least one of the following components: at least one measuring sensor for the acquisition of the medical data, such as the state of the cardiovascular and pulmonary system, as e.g. pulsation frequency, oxygen saturation of blood, breathing frequency, etc. of a human being or an animal, comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmit ted through a tissue portion of the person or the animal; Carlson at [0011]-[0012]. FIG. 2 schematically the ear clip of FIG. 1 in cross section view. Carlson at [0033].

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’304 Patent	Carlson
	 Figure 2 Carlson at Fig.2. In FIG. 2, the ear clip 1 is shown in cross section where it can specifically be seen that the sensor is designed in form on a clip 13. The sensor or ear clip 13 furthermore includes a light source 15 which emits a light beam 8 to a light receiver 11. The light is guided or emitted through the ear skin or earlobe 2. Carlson at [0049]. As already mentioned in the introduction, the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body. The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed. Carlson at [0050]. By using one of the proposed devices or methods, respectively, according to the present invention or a combination thereof, it is possible to use pulsoximetric measurement or monitoring to survey the health

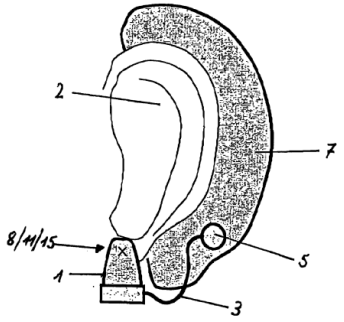
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’304 Patent	Carlson
	condition of a person or an animal which is mobile. In other words, pulsoximetric measurement is not restricted for use in, e.g., a hospital but can also be used, if a person is travelling, is staying at home, etc. Furthermore, it is also possible to study health conditions of animals living in nature such as e.g. cows feeding outside. Carlson at [0072].  Figure 1 Carlson at Fig.1. Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Carlson at [0073]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it

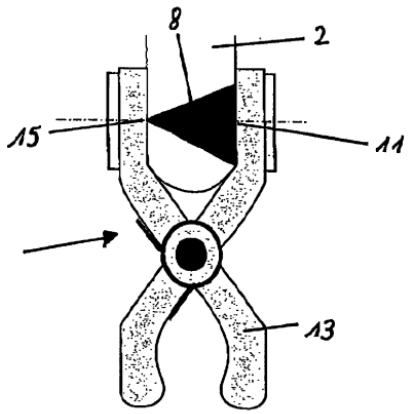
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’304 Patent	Carlson
	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a] a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Carlson discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths. FIG. 1 shows schematically the arrangement of an ear sensor 1 which can be arranged in form of an ear clip. This sensor 1 can be arranged e.g. at an earlobe of ear 2. Furthermore, the sensor or ear clip is connected via a wire 3 and the connection 5 with the main unit 7 including e.g. a power source, like a battery, and measuring and/or monitoring electronics. Carlson at [0048] Of course, the sensor can also be arranged at other parts of the human body, such as e.g. at a finger or a toe. In addition, the monitoring can also be executed at animals, which means that pulsoximetric sensors can also be arranged e.g. at the ear of animals, such as e.g. cows. According to an alternative design of the sensor, it could also be possible to arrange the light receiver in such a way so that the light reflected through the earlobe is determined. Again, according to a further alternative, it could even be possible by arranging at least two light receivers to determine the light transmitted through the earlobe and the light reflected by the earlobe. Carlson at [0052] By using one of the proposed devices or methods, respectively, according to the present invention or a combination thereof, it is possible to use pulsoximetric measurement or monitoring to survey the health condition of a person or an animal which is mobile. In other words, pulsoximetric measurement is not restricted for use in, e.g., a hospital but can also be used, if a person is travelling, is staying at home, etc. Furthermore, it is also possible to study health conditions of animals living in nature such as e.g. cows feeding outside. Carlson at [0072]

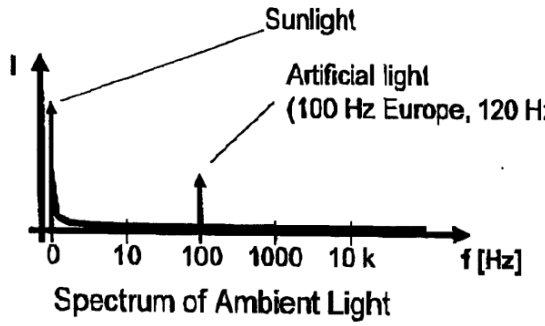
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’304 Patent	Carlson
	 Figure 1 Carlson at Fig.1. Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Carlson at [0073]. Comparing the clip mechanism according to FIGS. 1 and 2 and the frame 61 as shown in FIG. 10 a, it is obvious that in using a frame it is not easy to arrange or remove the pulsoximetric sensor to or from an earlobe of an ear, if required, e.g. if a person wearing the pulsoximetric sensor is taking a bath, a shower, etc. Therefore, it is proposed, as shown schematically in FIG. 10 b, to use a snap-in mechanism 71, which means that the clamp mechanism 63 holding the LED 15 can be rotated e.g. in direction ot dashed line 73 around an axis 69 and removed from the frame 61 or vice versa can be arranged at the frame 61 by arranging within the axis 69 and within the snap mechanism 71. Therefore, the LSD 15 has not to be rotated within the screw connection 65 between the clamp mechanism 63 for removing the frame 61 from an earlobe of an ear. Carlson at [0074].

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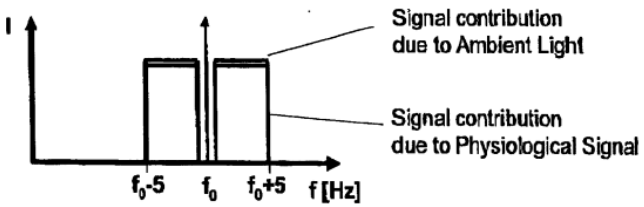
’304 Patent	Carlson
	 Figure 2 Carlson at Fig.2. In FIG. 2, the ear clip 1 is shown in cross section where it can specifically be seen that the sensor is designed in form on a clip 13. The sensor or ear clip 13 furthermore includes a light source 15 which emits a light beam 8 to a light receiver 11. The light is guided or emitted through the ear skin or earlobe 2. Carlson at [0049] As already mentioned in the introduction, the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body. The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed. Carlson at [0050] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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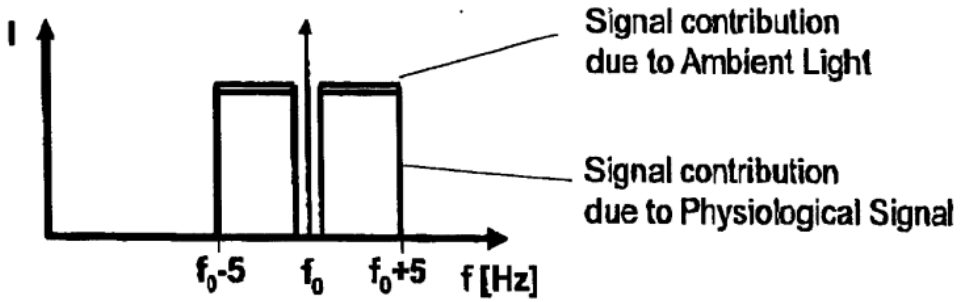
’304 Patent	Carlson
	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b] the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Carlson discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. By using sensor architecture as shown in FIG. 6 c, the Signal-to-Background ratio may be increased in a range of a factor 50 to 1000. According to a further aspect of the present invention, it is furthermore possible to use a light source modulation to temporarily modulate the optical radiation of the LED. The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3. Carlson at [0063-0065]  Figure 7b Carlson at Fig.7b.

’304 Patent	Carlson
	As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069]

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’304 Patent	Carlson
	 Figure 8 Carlson at Fig.8. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c] the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Carlson discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. FIG. 8 a diagram showing power spectrum of physiological signals and ambient light with phase shifting or modulation of the light source of a sensor. Carlson at [0045]

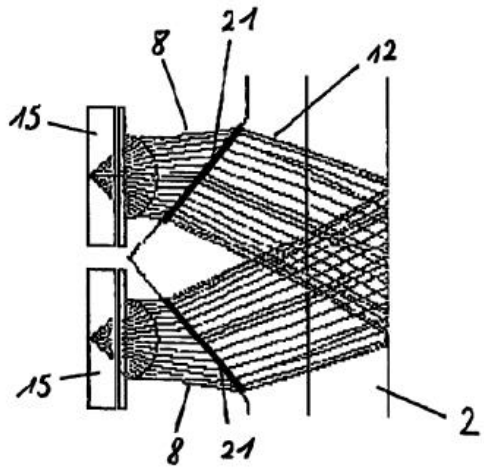
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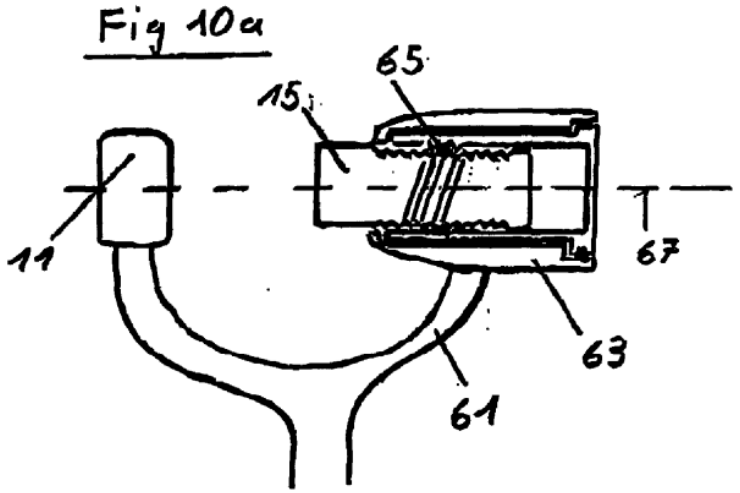
’304 Patent	Carlson
	 Figure 8 Carlson at Fig. 8. As already mentioned in the introduction, the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body. The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed. Carlson at [0050]. Therefore, it is proposed, as shown in FIG. 4, to use beam shaping optics 20 to direct the emitted optical radiation 8 emitted from the two LEDs 15 to the middle of the earlobe. As it is shown clearly in FIG. 4, using the beam shaping optics 21, the two initial light beams 8 are guided in form of bundled beams 12 to a relatively small area within the middle ear 2. By using the beam shaping optics 21, of course the influence of environmental light or noise, respectively, can be reduced substantially by increasing the S/B ratio. First or all, the light beam is bundled and, in addition, the optical signal power can be increased.

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’304 Patent	Carlson
	Carlson at [0054]. According to the preferred embodiment of the invention, the various described optical and geometric means, such as the beam shaping element as shown in FIG. 4, the wavelength filters, the sensor architecture, and the mentioned baffles, can be combined as shown in principle and perspective view in FIG. 6 c. Again, light is emitted from the two LEDs 15 and is shaped by the two beam shaping elements or lenses 21 to be guided as beams 12 through the earlobe 2. After the earlobe, the double pass filter 33 is arranged to guarantee that only light in the range of approximately 660 nm and in the range of approximately 890 nm is transmitted through the filter. After the filter, any stray light, entered the sensor e.g. trough the earlobe from the side, will be trapped within the baffles 37 which are arranged in circumferential direction. Finally, a photo detecting element 35 is arranged with specific spectrum sensitivity. Carlson at [0062]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d] the wearable measurement device further comprising a receiver configured to:	Carlson discloses or renders obvious the wearable measurement device further comprising a receiver. Within the main unit 7 the measured values can be compared with reference values being representative for a certain health status of the person to be surveyed. Carlson at [0051] Of course, the sensor can also be arranged at other parts of the human body, such as e.g. at a finger or a toe. In addition, the monitoring can also be executed at animals, which means that pulsoximetric sensors can also be arranged e.g. at the ear of animals, such as e.g. cows. According to an alternative design of the sensor, it could also be possible to arrange the light receiver in such a way so that the light reflected through the earlobe is determined. Again, according to a further alternative, it could even be possible by

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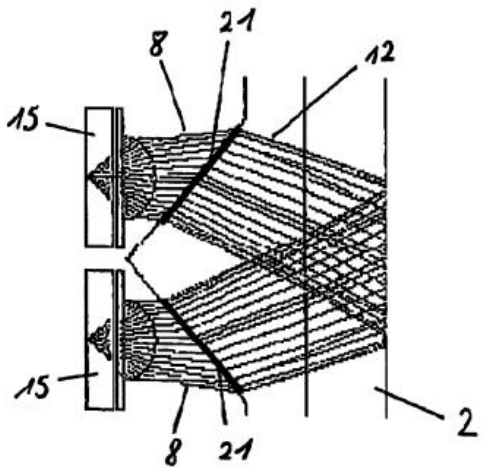
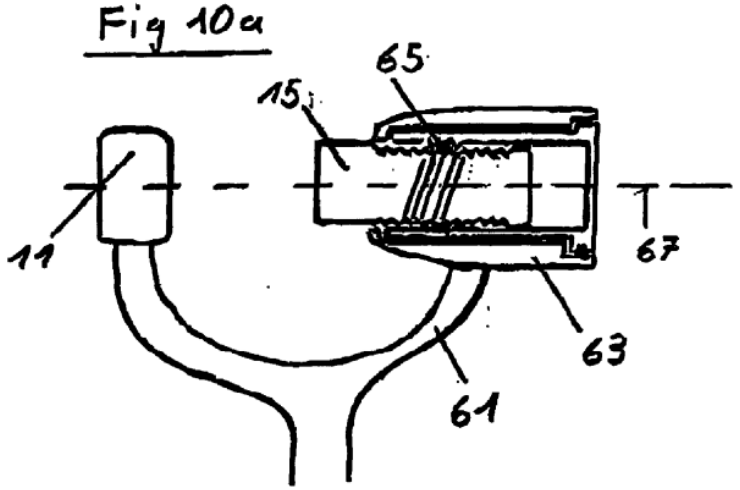
’304 Patent	Carlson
	arranging at least two light receivers to determine the light transmitted through the earlobe and the light reflected by the earlobe. Carlson at [0052]  Figure 4 Carlson at Fig.4. Of course, it is furthermore possible to combine wavelength filters, wavelength sensitive receivers like photodiodes, with beam shaping optics as described with reference to FIG. 4. Carlson at [0058]

’304 Patent	Carlson
	 Carlson at Fig.10a. In this case, of course, other means have to be provided, so that the distance between the LED 15 and the photo detector 11 can be adjusted or adapted to the thickness of the tissue to be monitored. Therefore, according to FIG. 10 a, it is proposed that the LED 15 is arranged within a clamping mechanism 63 and that between the clamping mechanism 63 and the LED a screw connection 65 is arranged, so that the LED 15 can be moved into the clamping mechanism or out of the clamping mechanism 63. In other words, the distance between the LED 15 and the photo detector 11 can be adjusted along the optical axis 67 which guarantees that the beam path has always been co-linear with the optical axis 67 of the LED and the photo detector. Carlson at [0073] The invention, as described with reference to FIG. 1 to 10, is of course not limited to the examples as shown in FIG. 1 to 9, but can be differently designed combined with other features, etc. E.g. pulsoximetric measurements can also be done at other parts of the body like e.g. fingers or toes. In addition, not only one light source can be used for the measurement, but also two or even more light emitting sources. It is understood that also one, two, or more light receiving detectors can be used. Carlson at [0075]

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’304 Patent	Carlson
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e] receive and process at least a portion of the analysis output beam reflected or transmitted from the sample,	Lisogurski discloses or renders obvious the receiver configured to: receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. Within the main unit 7 the measured values can be compared with reference values being representative for a certain health status of the person to be surveyed. Carlson at [0051] Of course, the sensor can also be arranged at other parts of the human body, such as e.g. at a finger or a toe. In addition, the monitoring can also be executed at animals, which means that pulsoximetric sensors can also be arranged e.g. at the ear of animals, such as e.g. cows. According to an alternative design of the sensor, it could also be possible to arrange the light receiver in such a way so that the light reflected through the earlobe is determined. Again, according to a further alternative, it could even be possible by arranging at least two light receivers to determine the light transmitted through the earlobe and the light reflected by the earlobe. Carlson at [0052]

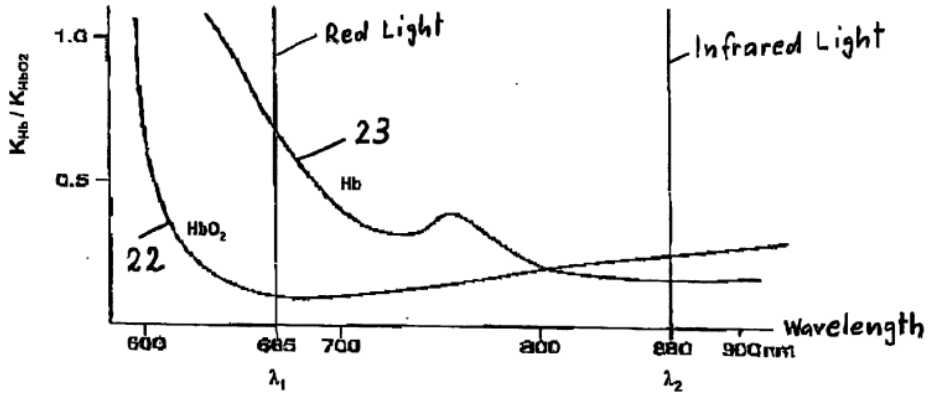
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’304 Patent	Carlson
	 Figure 4 Carlson at Fig. 4. Of course, it is furthermore possible to combine wavelength filters, wavelength sensitive receivers like photodiodes, with beam shaping optics as described with reference to FIG. 4. Carlson at [0058] 

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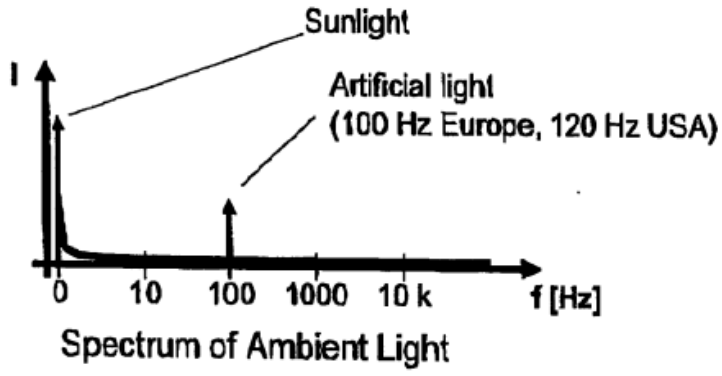
’304 Patent	Carlson
	Carlson at Fig. 10a. In this case, of course, other means have to be provided, so that the distance between the LED 15 and the photo detector 11 can be adjusted or adapted to the thickness of the tissue to be monitored. Therefore, according to FIG. 10 a, it is proposed that the LED 15 is arranged within a clamping mechanism 63 and that between the clamping mechanism 63 and the LED a screw connection 65 is arranged, so that the LED 15 can be moved into the clamping mechanism or out of the clamping mechanism 63. In other words, the distance between the LED 15 and the photo detector 11 can be adjusted along the optical axis 67 which guarantees that the beam path has always been co-linear with the optical axis 67 of the LED and the photo detector. Carlson at [0073] The invention, as described with reference to FIG. 1 to 10, is of course not limited to the examples as shown in FIG. 1 to 9, but can be differently designed combined with other features, etc. E.g. pulsoximetric measurements can also be done at other parts of the body like e.g. fingers or toes. In addition, not only one light source can be used for the measurement, but also two or even more light emitting sources. It is understood that also one, two, or more light receiving detectors can be used. Carlson at [0075] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f] generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Carlson discloses or renders obvious the receiver configured to: generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. The invention relates in particular to optical pulsoximetry used for non-invasive measurement of pulsation and oxygen saturation in arterial human or animal blood, and is particularly concerned with increasing the technical performance of pulsoximetry in terms of quality and robustness of the measurement signal versus environmental disturbances and energy consumption.

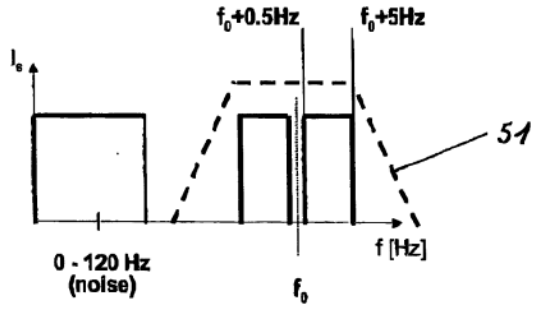
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	Carlson at [0002] As an alternative or in addition to using beam shaping optics, it is also possible to influence the sensor architecture of the pulsoximetric sensor. First of all, it is possible to use a light receiving or light sensitive element 11 with reduced light sensitivity outside the spectral range of the band limited light source as LEDs. FIG. 5 a shows the light absorption curves of with oxygen saturated 22 and unsaturated 23 blood. As visible from the shown diagram, the sensor architecture, which means the spectrum sensitivity, should be in the range within approximately 500 nm to approximately 1000 nm. In addition, in FIG. 5 a the two wavelengths λ1 and λ2 are indicated at which the pulsoximetric sensor is operated. Carlson at [0055]  Figure 5a Carlson at Fig. 5a. The invention, as described with reference to FIG. 1 to 10, is of course not limited to the examples as shown in FIG. 1 to 9, but can be differently designed combined with other features, etc. E.g. pulsoximetric measurements can also be done at other parts of the body like e.g. fingers or toes. In addition, not only one light source can be used for the measurement, but also two or even more light emitting sources. It is understood that also one, two, or more light receiving detectors can be used.

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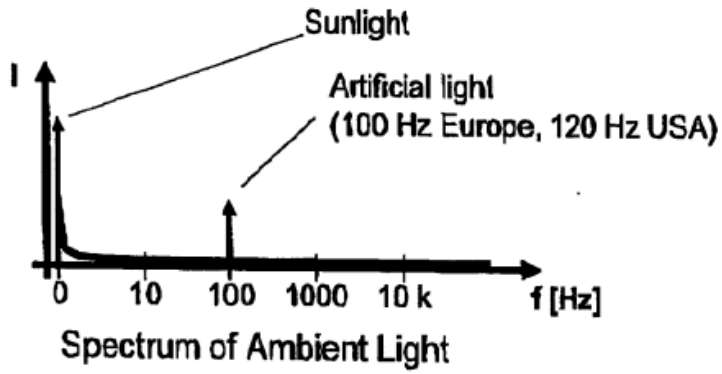
’304 Patent	Carlson
	Carlson at [0075] Furthermore, all the above mentioned means for improving the measurement of the oxygen saturation of blood using a light source can, of course, also be used by any further kind of measurements using a light source such as, e.g., non-invasive monitoring or arterial carbon dioxide partial tension, the content of blood sugar, etc. In other words, for any kind of measuring blood properties using light emission through a human or animal tissue, the above mentioned means for improving the measurement can be used. This means that the present invention is not at all restricted to optical pulsoximetry used for non-invasive measure of pulsation and oxygen saturation in arterial human or animal blood. Carlson at [0076] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g] synchronize to the light source,	Carlson discloses or renders obvious the receiver configured to: synchronize to the light source. At least one light source frequency modulating means to frequency modulate the optical radiation of the light source at a carrier frequency in order to shift the power spectrum of the pulsoximeter signals. The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the amplitude of the optical radiation of, e.g., the LED at a carrier frequency f. in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental opti cal radiation is unlikely and electronic band pass filtering is technologically less stringent. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmen tal optical radiation outside the frequency range of, e.g. f +/-5 HZ, increasing significantly the S/N (Signal/Noise)- and S/B ratio. Carlson at [0020] The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the

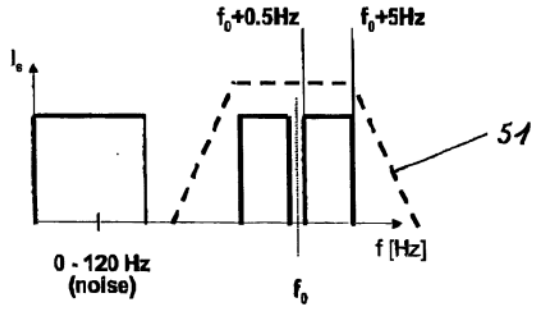
’304 Patent	Carlson
	power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3. Carlson at [0065] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h] capture light while the semiconductor sources are off and convert the captured light into a first signal,	Carlson discloses or renders obvious the receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal.  Figure 7b Carlson at Fig.7b. As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000

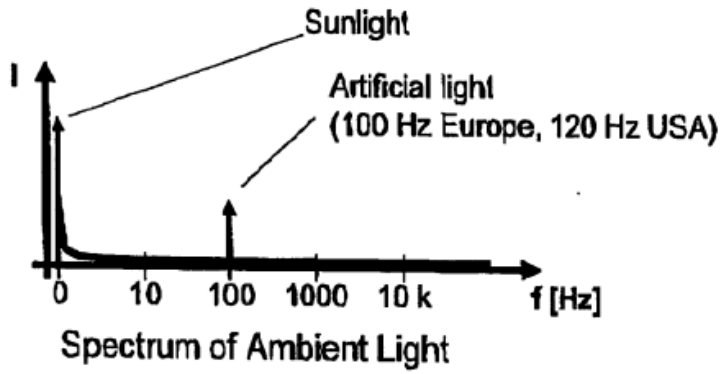
’304 Patent	Carlson
	Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069]  Figure 9 Carlson at Fig. 9.

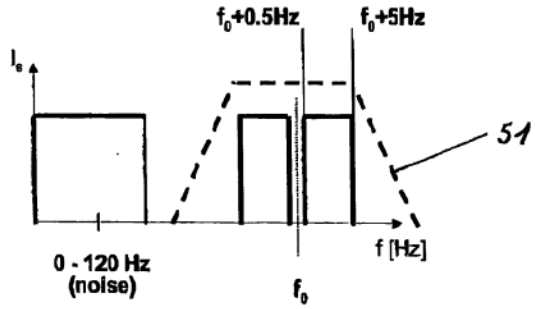
’304 Patent	Carlson
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i] capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Carlson discloses or renders obvious the receiver configured to: capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. Of course, the sensor can also be arranged at other parts of the human body, such as e.g. at a finger or a toe. In addition, the monitoring can also be executed at animals, which means that pulsoximetric sensors can also be arranged e.g. at the ear of animals, such as e.g. cows. According to an alternative design of the sensor, it could also be possible to arrange the light receiver in such a way so that the light reflected through the earlobe is determined. Again, according to a further alternative, it could even be possible by arranging at least two light receivers to determine the light transmitted through the earlobe and the light reflected by the earlobe. Carlson at [0052]

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	 Figure 7b Carlson at Fig.7b. As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The

’304 Patent	Carlson
	respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069]  Figure 9 Carlson at Fig.9. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j] wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Carlson discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal.

’304 Patent	Carlson
	 Figure 7b Carlson at Fig.7b. As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The

’304 Patent	Carlson
	respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069]  Figure 9 Carlson at Fig.9. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive	Carlson discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. The measured values can be transmitted via a wire connection or wireless, e.g. within the range of radio frequency. Well known these days is wireless transmission using “Bluetooth” technology. According to a further embodiment, the pulsoximetric sensor could be included within a hearing aid device. Taking

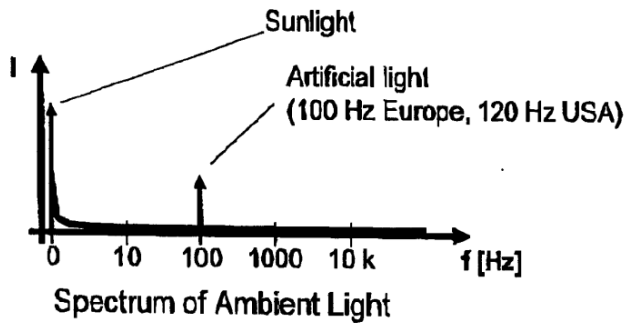
’304 Patent	Carlson
and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	prior art into consideration, the measured values can be monitored at a special unit worn by the person or patient, respectively, where e.g. a signal is generated, if the measured value is not within a predetermined range. In other words, health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0077-0078] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Carlson discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. The measured values can be transmitted via a wire connection or wireless, e.g. within the range of radio frequency. Well known these days is wireless transmission using “Bluetooth” technology. According to a further embodiment, the pulsoximetric sensor could be included within a hearing aid device. Taking prior art into consideration, the measured values can be monitored at a special unit worn by the person or patient, respectively, where e.g. a signal is generated, if the measured value is not within a predetermined range. In other words, health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0077-0078] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

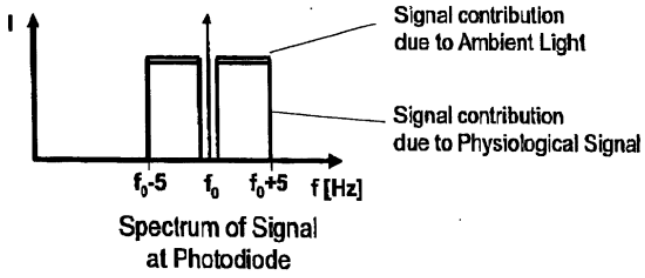
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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	Carlson discloses or renders obvious the measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. The measured values can be transmitted via a wire connection or wireless, e.g. within the range of radio frequency. Well known these days is wireless transmission using “Bluetooth” technology. According to a further embodiment, the pulsoximetric sensor could be included within a hearing aid device. Taking prior art into consideration, the measured values can be monitored at a special unit worn by the person or patient, respectively, where e.g. a signal is generated, if the measured value is not within a predetermined range. In other words, health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0077-0078] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein	Carlson discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set.

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the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	The measured values can be transmitted via a wire connection or wireless, e.g. within the range of radio frequency. Well known these days is wireless transmission using “Bluetooth” technology. According to a further embodiment, the pulsoximetric sensor could be included within a hearing aid device. Taking prior art into consideration, the measured values can be monitored at a special unit worn by the person or patient, respectively, where e.g. a signal is generated, if the measured value is not within a predetermined range. In other words, health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0077-0078] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Carlson discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. By using sensor architecture as shown in FIG. 6 c, the Signal-to-Background ratio may be increased in a range of a factor 50 to 1000. According to a further aspect of the present invention, it is furthermore possible to use a light source modulation to temporarily modulate the optical radiation of the LED. The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3. Carlson at [0063-0065]

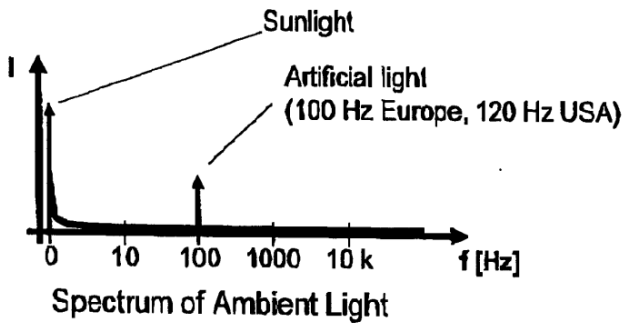
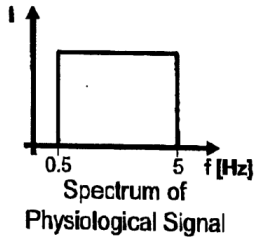
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’304 Patent	Carlson
	 Figure 7b Carlson at Fig.7b. As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz.

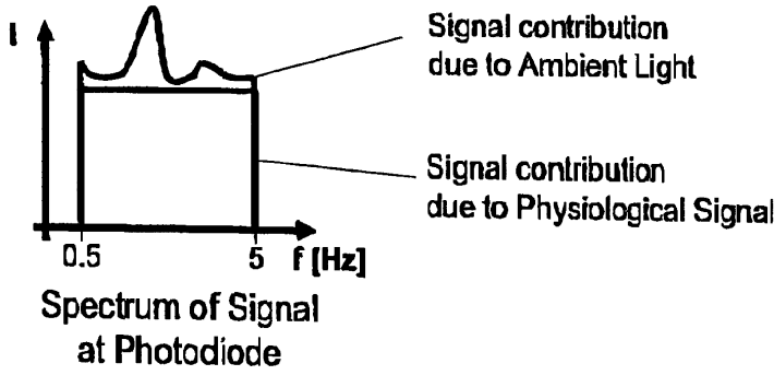
’304 Patent	Carlson
	Carlson at [0069]  Figure 8 Carlson at Fig. 8. The measured values can be transmitted via a wire connection or wireless, e.g. within the range of radio frequency. Well known these days is wireless transmission using “Bluetooth” technology. According to a further embodiment, the pulsoximetric sensor could be included within a hearing aid device. Taking prior art into consideration, the measured values can be monitored at a special unit worn by the person or patient, respectively, where e.g. a signal is generated, if the measured value is not within a predetermined range. In other words, health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0077-0078] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Carlson discloses or renders obvious the measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. According to the preferred embodiment of the invention, the various described optical and geometric means, such as the beam shaping element as shown in FIG. 4, the wavelength filters, the sensor architecture, and the mentioned baffles, can be combined as shown in principle and perspective view in FIG. 6 c. Again, light is emitted from the two LEDs 15 and is shaped by the two beam shaping elements or lenses 21 to be guided as beams 12 through the earlobe 2. After the earlobe, the double pass filter 33 is arranged to guarantee that only light in the range of approximately 660 nm and in the range of approximately 890 nm is transmitted through the filter. After the filter, any stray light, entered the sensor e.g. trough the earlobe from the side, will be trapped within the baffles 37 which are arranged in circumferential direction. Finally, a photo detecting element 35 is arranged with specific spectrum sensitivity. Carlson at [0062] By using sensor architecture as shown in FIG. 6 c, the Signal-to-Background ratio may be increased in a range of a factor 50 to 1000. According to a further aspect of the present invention, it is furthermore possible to use a light source modulation to temporarily modulate the optical radiation of the LED. The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3. Carlson at [0063-0065]

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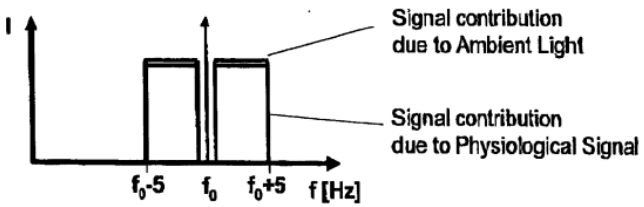
’304 Patent	Carlson
	 Figure 7b Carlson at Fig. 7b. FIG. 7 a shows a spectrum of physiological signals, such as pulsation frequency, breathing frequency, etc. The frequency of physiological events is within the range of approximately 0.5 Hz (30 heartbeats in one minute) up to approximately 3 Hz (180 heartbeats in one minute) that can be even higher and therefore is supposed to go up to 5 Hz. Carlson at [0066]  Figure 7a Carlson at Fig. 7a. The frequency spectrum of ambient light is schematically shown in diagram 7 b. Sunlight is at 0 Hz, while artificial light, such as e.g. electrical in-house light, is going up to approximately 120 Hz (USA). In other words, within the range of frequencies of physiological signals, we have high influence of

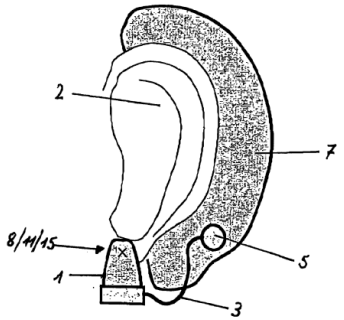
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	frequencies of sunlight and ambient light. A corresponding combined frequency spectrum is shown in Fig. c, which would be detected by a photo diode without the use of any means as described above in relation to FIGS. 1 to 6. FIG. 7 c shows a basic signal contribution due to physiological signal and additional signal contribution due to ambient light. In other words, the influence of ambient light is quite substantial, and therefore the deviations of the measured values compared to the real values can be dramatic. Carlson at [0067]. Besides the high influence of ambient light, also sunlight can have a dramatic influence, e.g. if a person is walking through streets with relatively quick changing conditions between sunlight and shadow. Another serious possibility is caused by a tree avenue when driving along the trees. Sunlight then is received e.g. by the pulsoximetric sensor at a certain frequency, which means that every time when passing a tree, sunlight is attenuated and between the trees sunlight is influencing the measurement of the pulsoximetric sensor Carlson at [0068].  Figure 7c Carlson at Fig. 7c.

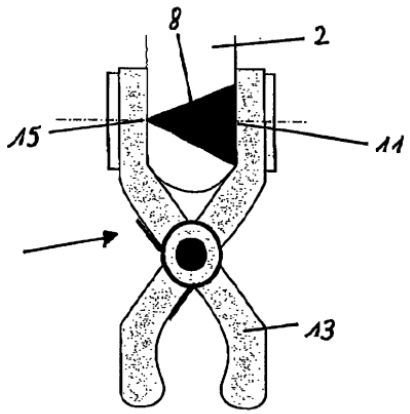
’304 Patent	Carlson
	As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069]

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	 Figure 8 Carlson at Fig. 8. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and	Carlson discloses or renders obvious the measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above. By using one of the proposed devices or methods, respectively, according to the present invention or a combination thereof, it is possible to use pulsoximetric measurement or monitoring to survey the health condition of a person or an animal which is mobile. In other words, pulsoximetric measurement is not restricted for use in, e.g., a hospital but can also be used, if a person is travelling, is staying at home, etc.

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redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Furthermore, it is also possible to study health conditions of animals living in nature such as e.g. cows feeding outside. Carlson at [0072]  Figure 1 Carlson at Fig.1. Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Carlson at [0073]

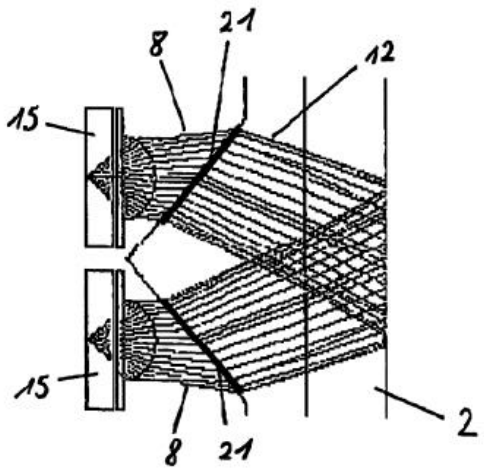
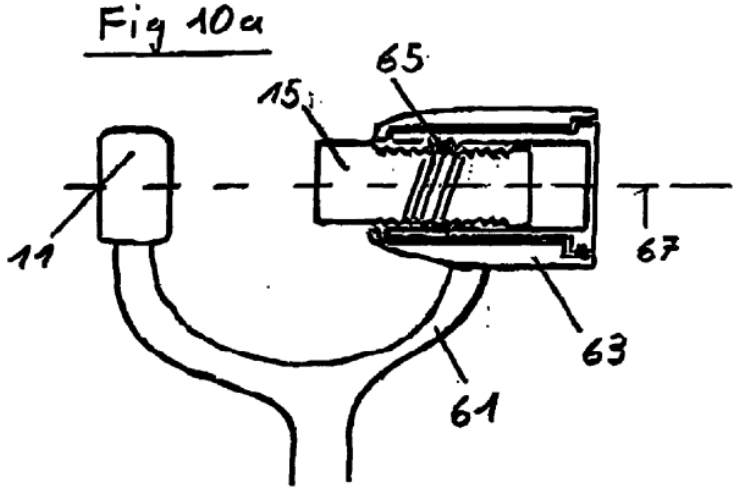
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	 Figure 2 Carlson at Fig. 2. In FIG. 2, the ear clip 1 is shown in cross section where it can specifically be seen that the sensor is designed in form on a clip 13. The sensor or ear clip 13 furthermore includes a light source 15 which emits a light beam 8 to a light receiver 11. The light is guided or emitted through the ear skin or earlobe 2. Carlson at [0049] As already mentioned in the introduction, the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body. The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed. Carlson at [0050] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Carlson discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above. Within the main unit 7 the measured values can be compared with reference values being representative for a certain health status of the person to be surveyed. Carlson at [0051] Of course, the sensor can also be arranged at other parts of the human body, such as e.g. at a finger or a toe. In addition, the monitoring can also be executed at animals, which means that pulsoximetric sensors can also be arranged e.g. at the ear of animals, such as e.g. cows. According to an alternative design of the sensor, it could also be possible to arrange the light receiver in such a way so that the light reflected through the earlobe is determined. Again, according to a further alternative, it could even be possible by arranging at least two light receivers to determine the light transmitted through the earlobe and the light reflected by the earlobe. Carlson at [0052]

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	 Figure 4 Carlson at Fig.4. Of course, it is furthermore possible to combine wavelength filters, wavelength sensitive receivers like photodiodes, with beam shaping optics as described with reference to FIG. 4. Carlson at [0058] 

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	Carlson at Fig. 10a. In this case, of course, other means have to be provided, so that the distance between the LED 15 and the photo detector 11 can be adjusted or adapted to the thickness of the tissue to be monitored. Therefore, according to FIG. 10 a, it is proposed that the LED 15 is arranged within a clamping mechanism 63 and that between the clamping mechanism 63 and the LED a screw connection 65 is arranged, so that the LED 15 can be moved into the clamping mechanism or out of the clamping mechanism 63. In other words, the distance between the LED 15 and the photo detector 11 can be adjusted along the optical axis 67 which guarantees that the beam path has always been co-linear with the optical axis 67 of the LED and the photo detector. Carlson at [0073] The invention, as described with reference to FIG. 1 to 10, is of course not limited to the examples as shown in FIG. 1 to 9, but can be differently designed combined with other features, etc. E.g. pulsoximetric measurements can also be done at other parts of the body like e.g. fingers or toes. In addition, not only one light source can be used for the measurement, but also two or even more light emitting sources. It is understood that also one, two, or more light receiving detectors can be used. Carlson at [0075] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Carlson discloses or renders obvious the measurement system of claim 15, wherein the first arc and the second arc are concentric. *See* claim 15 above.

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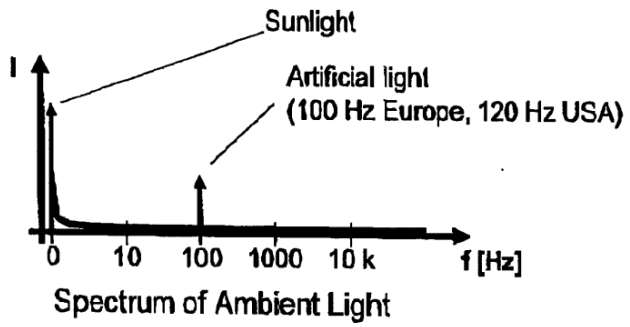
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Carlson discloses or renders obvious a wearable device for use with a smart phone or tablet, the wearable device. *See* 11[a], 11[k] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	Carlson discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* 11[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

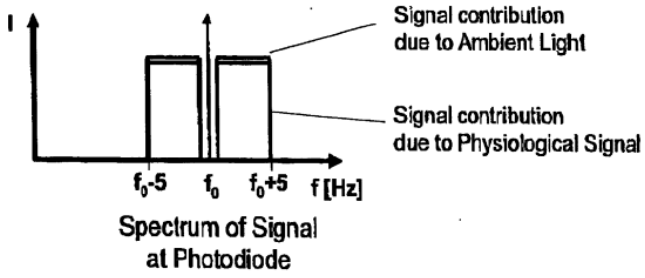
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EXHIBIT D2

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19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Carlson discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths. As already mentioned in the introduction, the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body. The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed. Carlson at [0050] By using sensor architecture as shown in FIG. 6 c, the Signal-to-Background ratio may be increased in a range of a factor 50 to 1000. According to a further aspect of the present invention, it is furthermore possible to use a light source modulation to temporarily modulate the optical radiation of the LED. The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3. Carlson at [0063-0065]

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’304 Patent	Carlson
	 Figure 7b Carlson at Fig. 7b. As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz.

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	Carlson at [0069]  Figure 8 Carlson at Fig. 8. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Carlson discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;	Carlson disloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue. *See* 11[d], 11[h], 11[i], 19[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Carlson discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical	Carlson discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal.

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beam reflected from the tissue by: differencing the first signal and the second signal, and	*See* 11[b], 11[h], 11[i], 11[j], 19[a], 19[d] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Carlson discloses or renders obvious the measurement device further configured to increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[a], 11[b], 19[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Carlson discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Carlson discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* 11[k], 19[pre] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link.	Carlson discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of	Carlson discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claims 19, 13 above.

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the plurality of semiconductor sources from an initial non-zero pulse rate.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Carlson discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claims 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Carlson discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claims 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D3

U.S. Pat. No. 10,874,304 in view of U.S. Patent No. 6,616,613 to Jesse B. Goodman ("Goodman")

As described in detail below, Goodman (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either alone in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D2 and D4-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Goodman. The cited portions of Goodman are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Goodman. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Goodman"describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Goodmand does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Goodman (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Goodman anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

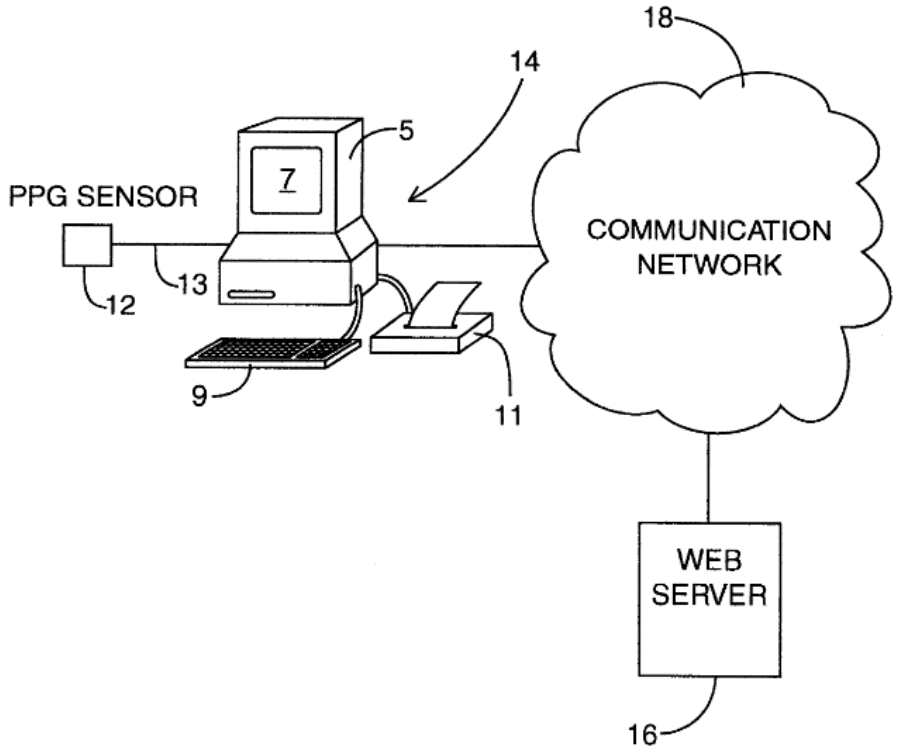
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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EXHIBIT D3

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Claim 11	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Goodman discloses or renders obvious a measurement system. A health monitoring and biofeedback system comprising a photoplethysmography (PPG) sensor, a processing device, and a Web site server for determining, displaying and analyzing various cardiovascular parameters. The PPG sensor is installed within a manually operated user input device such as a mouse or keyboard, measures a user's blood volume contour and transmits it to a processing device such as a personal computer or a personal digital assistant (PDA). The system determines a plurality of cardiovascular indices including mean blood pressure, heart rate, body temperature, respiratory rate, and arterial compliance on the basis of signal characteristics of the systolic wave pulse and the systolic reflected wave pulse present within the digital volume pulse derived from the PPG pulse contour. Signal characteristics of the systolic reflected wave pulse can be determined through various pulse analysis techniques including derivative analysis of the digital volume pulse signal, bandpass filtering or respiratory matrix frequency extraction techniques. By subtracting the systolic reflected wave pulse contour from the digital volume pulse contour, characteristics of the systolic wave pulse can also be identified. The system also provides for the accurate determination of systolic and diastolic blood pressure by using a non-invasive blood pressure monitor to calibrate the relationships between arterial or digital blood pressure and characteristics of the user's digital volume pulse contour. In this way, a wide variety of cardiovascular and respiratory data can be obtained. The system also facilitates the transmittal of such data to the system web site for further analysis, storage, and retrieval purposes. Goodman at Abstract.

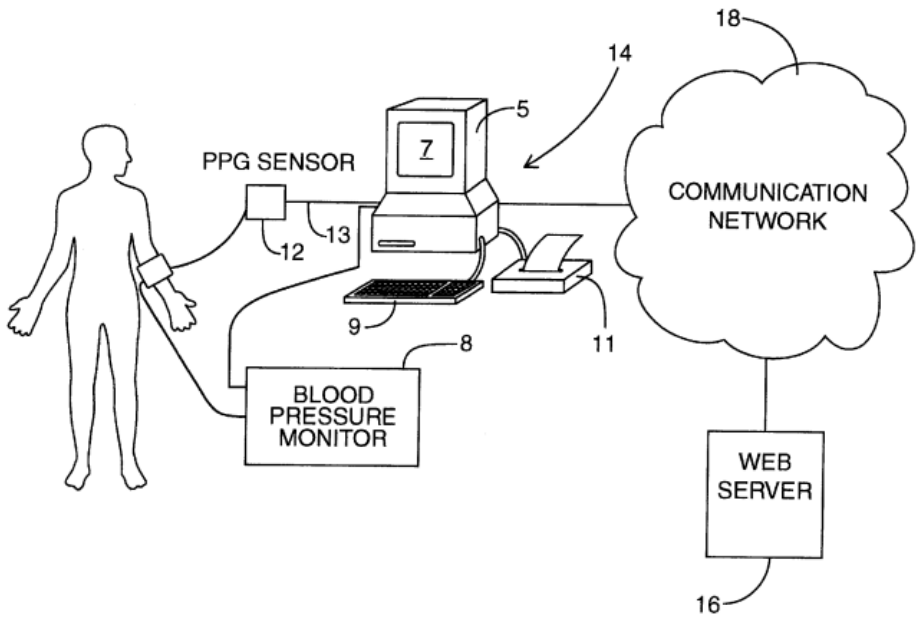
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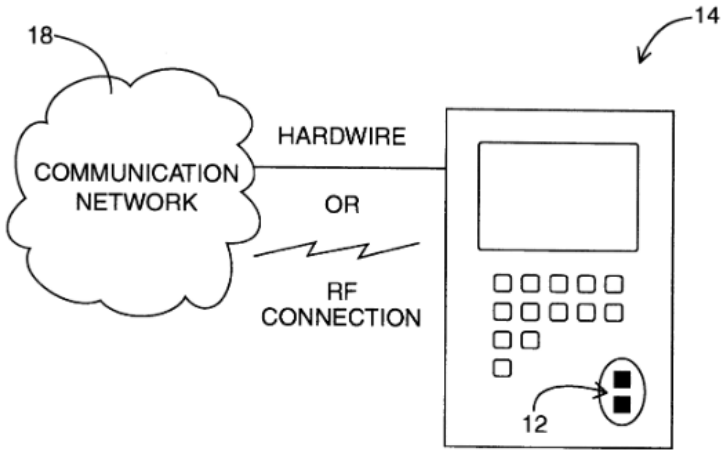
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	 Goodman at Fig.1. This invention relates to a physiological Signal monitor ing System and more particularly to a System which allows a user to determine various types of physiological informa tion and which allows a user to electronically access this information over a communication network. Goodman at 1:5-10. Reference is first made to FIG. 1, which shows the overall configuration of the preferred embodiment of a physiologi cal monitoring System 10, according to the present inven tion. System 10 comprises a conventional plethysmography (PPG) sensor 12 coupled to a processing device 14 which is in data communication with a Web site server 16 through a communication network 18 (i.e. the Internet).

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	Goodman at 8:53-59. PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse or some other computer peripheral (e.g. keyboard, touchpad, joystick) commonly associated with a computer processing device 14. It should be understood that it would be also possible to implement the invention by incorporating PPG sensor 12 within the casing of a personal digital assistant (PDA) or within some other type of stand alone data processing and transmitting device (e.g. a watch) or simply as a stand alone sensor device. Goodman at 8:60-9:5. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 9:57-10:5.

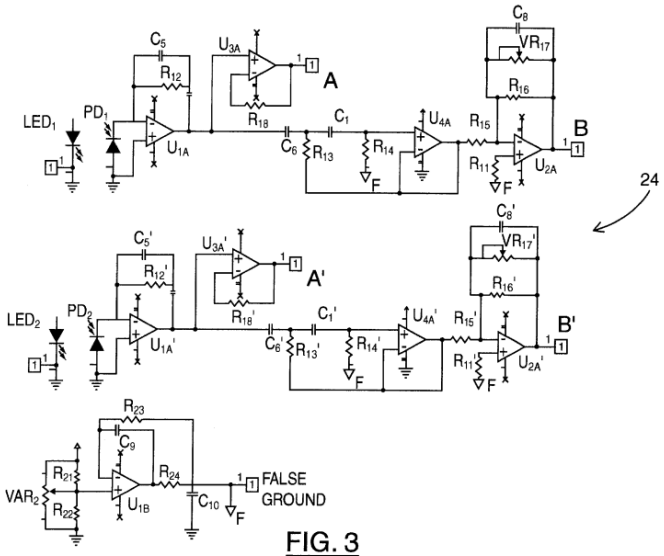
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	 FIG. 15B Goodman at Fig. 15b One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters,	Goodman discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths.

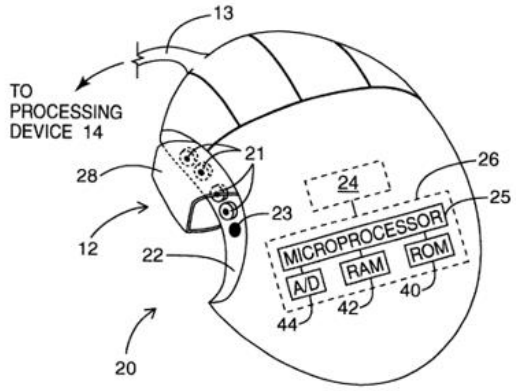
’304 Patent	Goodman
including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	 FIG. 5 Goodman at Fig.5. FIG. 5 shows another possible configuration of system 10 wherein processing device 14 is a PDA (e.g. Palm Pilot™) having PPG sensor 12 interfaced therein. PPG sensor 12 could be directly integrated into the shell of the PDA processing device 14. Alternatively, PPG sensor 12 could be implemented within a PDA accessory card or device, or adapted to interface with the PDA processing device 14 as an external wearable device. In the latter case, it would be possible for a user to wear a wearable user input device 12 such that blood volume pulse signal information could be collected by the PDA processing device 14 over the course of a day. It would be possible to arrange for periodic download of recorded volume pulse contour signal information collected by user input device 12 to processing device 14 and/or to Web site server 16 through processing device 14 over the communication network 18. Goodman at 13:26-42. Further embodiments of the invention whereby PPG sensor 12 and processing device 14 are integrated together into a single unit with a compact design are also contemplated as processing speed and device memory increase as physical dimensions decrease. For example, it is likely that PPG sensor 12 and processing device 14, and all of its associated functionality, could feasibly be incorporated into a wrist watch device in the foreseeable future. It is contemplated that PPG sensor 12 could be integrated together

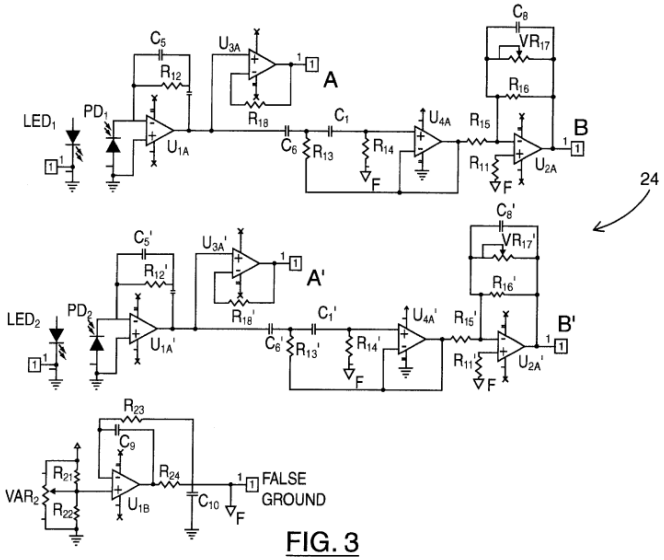
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	with a computing means, wireless transmission means (e.g. well known convention radio frequency techniques as well as emerging radio frequency communication protocols such as the BlueTooth™ standard) and a battery in a small (e.g. 2 cm2) component that would adhere to a body skin area for extended periods of time (e.g. weeks) and would transmit data to a remote computing device on a continuous basis. Goodman at 13:43-58. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 9:57-10:5. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light	Goodman discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources.

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intensity from at least one of the plurality of semiconductor sources;	 FIG. 3 Goodman at Fig.3. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 9:57-10:5. Following this filtering process, the PPG voltage signal is applied to a combined amplifier and low pass filter stage comprised of resistors R15, R11, and R16, variable resistor VAR17, capacitor C8 and

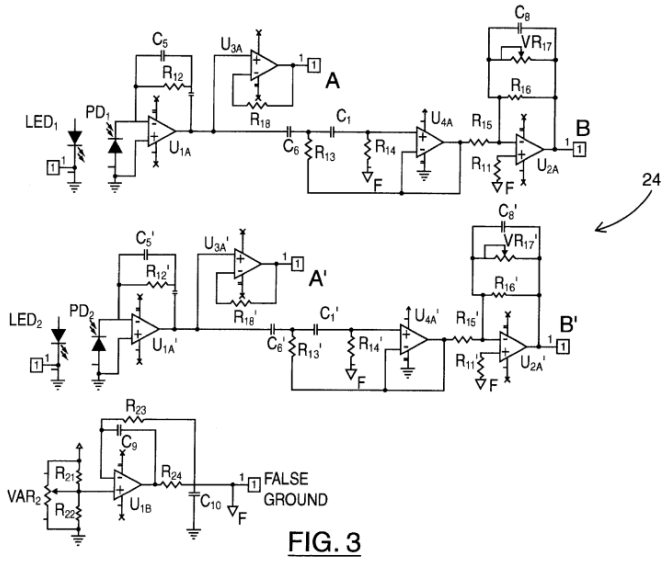
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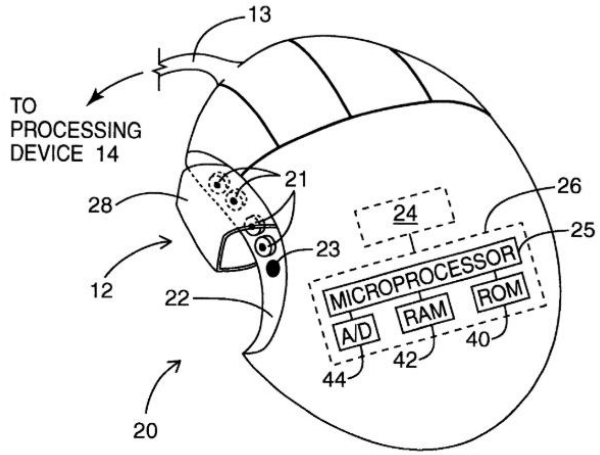
’304 Patent	Goodman
	operational amplifier U2A. The gain of the amplifier is set by adjusting variable resistor VAR17. The values of resistors R16, R17 and capacitor C8 determine the corner frequency which is typically 30 Hertz. The conditioned PPG voltage signal generated by this stage (at point B) is provided to the processing device 14. In this way signal conditioner module 24 improves the signal to noise ratio of the PPG signal prior to digitization. Goodman at 11:41-52.  FIG. 2 Goodman at Fig. 2. “Microcontroller 26 is also programmed to control the operation of LED1 and LED2 of PPG sensor 12 for optimal sensor operation. Microcontroller 26 is programmed to generate digital switching pulses to drive LED1 and LED2 of PPG sensor 12 alternately at a repetition rate of 1 KHz (i.e. each LED accomplishes sampling at a rate of 1 KHz). It has been determined that the sampling frequency should be 10 times the highest frequency of interest. The conditioned PPG signal has frequency components as high as 30 Hertz. However, 60 Hertz noise from electrical sources in the environment necessitates sampling of the signal at a high enough rate to ensure the effectiveness of the associated noise filtering software of CPU 5. By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable

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	LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary.” Goodman at 12:12-48. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Goodman discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample..  FIG. 3 Goodman at Fig.3.

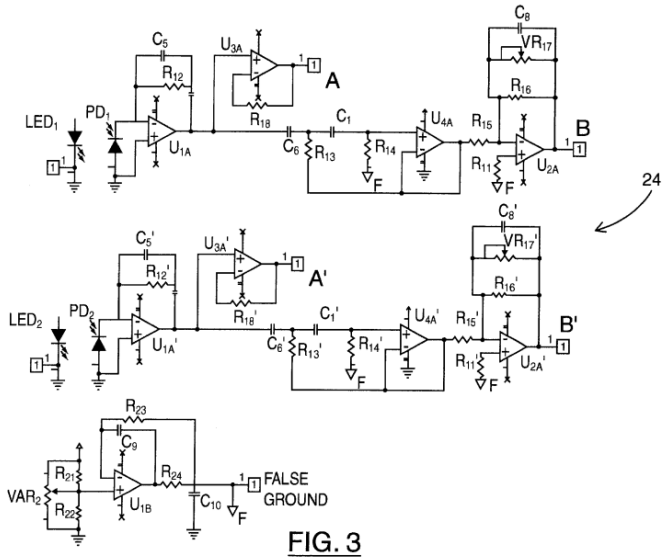
’304 Patent	Goodman
	PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 9:57-10:5. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d]. the wearable measurement device further comprising a receiver configured to:	Goodman discloses or renders obvious the wearable measurement device further comprising a receiver.

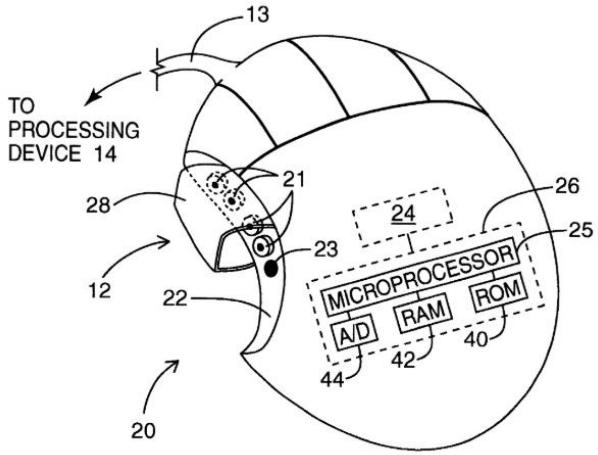
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’304 Patent	Goodman
	 FIG. 3 Goodman at Fig.3. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 9:57-10:5.

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	 Goodman at Fig. 2. Accordingly, the PPG voltage signal from photodiodes PD1 and PD2 is converted into conditioned PPG voltage signals at outputs at nodes B and B′, respectively. These conditioned PPG voltage signals are provided to microcontroller 26 for digitizing and analysis. Microcontroller 26 (FIG. 2) may be any commercially available programmable device such as a Mitsubishi USB microcontroller (available from Mitsubishi Semiconductors, Inc. of Japan), although it should be understood that any type of logic circuit with similar operating functions (particularly one which has a USB interface and which includes an on-board analog-to-digital converter) can be utilized. Storage of program instructions and other static data is provided by a read only memory (ROM) 40, while storage of dynamic data is provided by a random access memory (RAM) 42. Both memory units 40 and 42 are controlled and accessed by microprocessor 25. On board analog-to-digital converter A/D 44 (10 bit, 5 channel input) is used to convert the conditioned PPG signals at B and B′ into time sampled digital signals which are then provided to processing device 14. Also, all of the circuitry of signal conditioner module 24 is provided with a 5 volt source from the USB line of microcontroller 26. Goodman at 11:66-12:21. The difference in shape occurs because of the diffusion of light in the finger as it travels from the light Source, through tissue to arterial elements and back to the photodetector. This diffusion smooths the shape of the DVP signal relative to the pressure pulse contour.

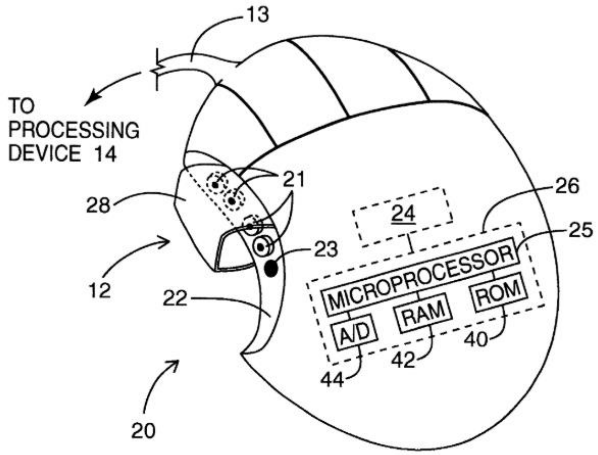
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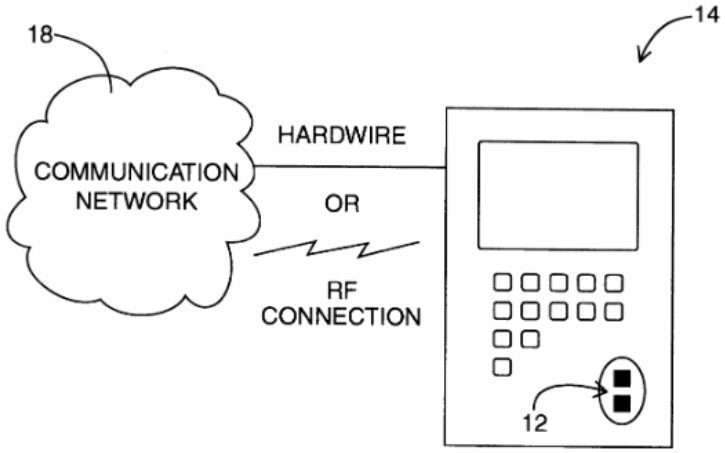
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	Goodman at 26:55-60. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample,	Goodman discloses or renders obvious the receiver configured to: receive and process at least a portion of the analysis output beam reflected or transmitted from the sample.  FIG. 3 Goodman at Fig.3. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known

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	configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 9:57-10:5.  Goodman at Fig. 2. Accordingly, the PPG voltage signal from photodiodes PD1 and PD2 is converted into conditioned PPG voltage signals at outputs at nodes B and B′, respectively. These conditioned PPG voltage signals are provided to microcontroller 26 for digitizing and analysis. Microcontroller 26 (FIG. 2) may be any commercially available programmable device such as a Mitsubishi USB microcontroller (available from Mitsubishi Semiconductors, Inc. of Japan), although it should be understood that any type of logic circuit with similar operating functions (particularly one which has a USB interface and which includes an on-board analog-to-digital converter) can be utilized. Storage of program instructions and other static data is provided by a read only memory (ROM) 40,

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	while storage of dynamic data is provided by a random access memory (RAM) 42. Both memory units 40 and 42 are controlled and accessed by microprocessor 25. On board analog-to-digital converter A/D 44 (10 bit, 5 channel input) is used to convert the conditioned PPG signals at B and B′ into time sampled digital signals which are then provided to processing device 14. Also, all of the circuitry of signal conditioner module 24 is provided with a 5 volt source from the USB line of microcontroller 26. Goodman at 11:66-12: 21. The difference in shape occurs because of the diffusion of light in the finger as it travels from the light Source, through tissue to arterial elements and back to the photodetector. This diffusion smooths the shape of the DVP signal relative to the pressure pulse contour. Goodman at 26:55-60. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Goodman discloses or renders obvious the receiver configured to: generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. A health monitoring and biofeedback system comprising a photoplethysmography (PPG) sensor, a processing device, and a Web site server for determining, displaying and analyzing various cardiovascular parameters. The PPG sensor is installed within a manually operated user input device such as a mouse or keyboard, measures a user's blood volume contour and transmits it to a processing device such as a personal computer or a personal digital assistant (PDA). The system determines a plurality of cardiovascular indices including mean blood pressure, heart rate, body temperature, respiratory rate, and arterial compliance on the basis of signal characteristics of the systolic wave pulse and the systolic reflected wave pulse present within the digital volume pulse derived from the PPG pulse contour. Signal characteristics of the systolic reflected wave pulse can be determined through various pulse analysis techniques including derivative analysis of the digital volume pulse signal, bandpass

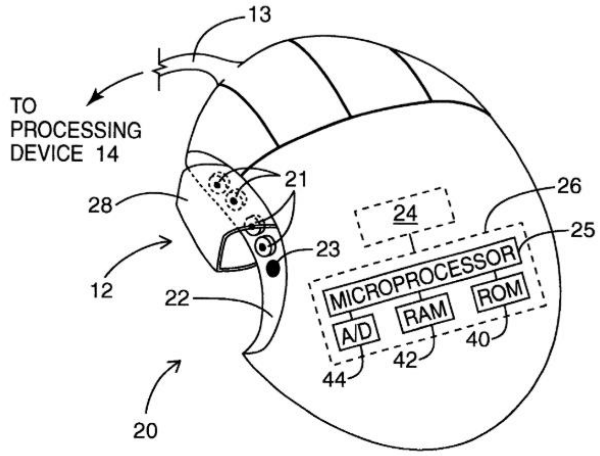
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	filtering or respiratory matrix frequency extraction techniques. By subtracting the systolic reflected wave pulse contour from the digital volume pulse contour, characteristics of the systolic wave pulse can also be identified. The system also provides for the accurate determination of systolic and diastolic blood pressure by using a non-invasive blood pressure monitor to calibrate the relationships between arterial or digital blood pressure and characteristics of the user's digital volume pulse contour. In this way, a wide variety of cardiovascular and respiratory data can be obtained. The system also facilitates the transmittal of such data to the system web site for further analysis, storage, and retrieval purposes. Goodman at Abstract. Since PPG sensors operate non-invasively, efforts have been made to utilize them to determine estimates of mean, Systolic and diastolic blood pressure. These devices either estimate mean blood pressure from the mean value of the blood Volume pulse, a measure of pulse wave Velocity or changes in the Volume pulse contour using formulae and calibrated constants. However, these devices have not achieved widespread use due to a lack of accuracy and difficulty of use. Goodman at 1:50-58.  Goodman at Fig. 2.

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	Accordingly, the PPG voltage signal from photodiodes PD1 and PD2 is converted into conditioned PPG voltage signals at outputs at nodes B and B′, respectively. These conditioned PPG voltage signals are provided to microcontroller 26 for digitizing and analysis. Microcontroller 26 (FIG. 2) may be any commercially available programmable device such as a Mitsubishi USB microcontroller (available from Mitsubishi Semiconductors, Inc. of Japan), although it should be understood that any type of logic circuit with similar operating functions (particularly one which has a USB interface and which includes an on-board analog-to-digital converter) can be utilized. Storage of program instructions and other static data is provided by a read only memory (ROM) 40, while storage of dynamic data is provided by a random access memory (RAM) 42. Both memory units 40 and 42 are controlled and accessed by microprocessor 25. On board analog-to-digital converter A/D 44 (10 bit, 5 channel input) is used to convert the conditioned PPG signals at B and B′ into time sampled digital signals which are then provided to processing device 14. Also, all of the circuitry of signal conditioner module 24 is provided with a 5 volt source from the USB line of microcontroller 26. Goodman at 11:66-12: 21.  FIG. 5 Goodman at Fig.5. FIG. 5 shows another possible configuration of system 10 wherein processing device 14 is a PDA (e.g. Palm Pilot™) having PPG sensor 12 interfaced therein. PPG sensor 12 could be directly integrated into

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	the shell of the PDA processing device 14. Alternatively, PPG sensor 12 could be implemented within a PDA accessory card or device, or adapted to interface with the PDA processing device 14 as an external wearable device. In the latter case, it would be possible for a user to wear a wearable user input device 12 such that blood volume pulse signal information could be collected by the PDA processing device 14 over the course of a day. It would be possible to arrange for periodic download of recorded volume pulse contour signal information collected by user input device 12 to processing device 14 and/or to Web site server 16 through processing device 14 over the communication network 18. Goodman at 13:26-42. Blood oxygen Saturation is a physiological parameters of critical importance in many medical conditions. The non invasive measurement of arterial oxygen Saturation using PPG sensors known as pulse oximetry is well established in clinical use. The technique relies on the knowledge that haemoglobin and oxygenated haemoglobin absorb incident light to varying degrees as a function of wavelength. Goodman at 32:30-36. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	Goodman discloses or renders obvious the receiver configured to synchronize to the light source. Following this filtering process, the PPG voltage signal is applied to a combined amplifier and low pass filter stage comprised of resistors R15, R11, and R16, variable resistor VAR17, capacitor C8 and operational amplifier U2A. The gain of the amplifier is set by adjusting variable resistor VAR17. The values of resistors R16, R17 and capacitor C8 determine the corner frequency which is typically 30 Hertz. The conditioned PPG voltage signal generated by this stage (at point B) is provided to the processing device 14. In this way signal conditioner module 24 improves the signal to noise ratio of the PPG signal prior to digitization.

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	Goodman at 11:41-52.  Goodman at Fig. 2. “Microcontroller 26 is also programmed to control the operation of LED1 and LED2 of PPG sensor 12 for optimal sensor operation. Microcontroller 26 is programmed to generate digital switching pulses to drive LED1 and LED2 of PPG sensor 12 alternately at a repetition rate of 1 KHz (i.e. each LED accomplishes sampling at a rate of 1 KHz). It has been determined that the sampling frequency should be 10 times the highest frequency of interest. The conditioned PPG signal has frequency components as high as 30 Hertz. However, 60 Hertz noise from electrical sources in the environment necessitates sampling of the signal at a high enough rate to ensure the effectiveness of the associated noise filtering software of CPU 5.” Goodman at 12:12-34. The interaction between primary and reflected waves obscures wave detail preventing the determination of exact timing and amplitude relationships between primary and reflected waves. Also, the shape of the DVP changes on a beat to beat basis due to changes in the timing and amplitude of the reflected wave components associated with respiration. With inspiration, blood pressure falls and the aortic reflected waves will arrive later at the finger and with smaller amplitude. As blood pressure decreases, the pulse

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	transit time increases. This inverse relationship between blood pressure and pulse transit time causes the reflected wave signal to appear earlier or later in the DVP signal. Goodman at 20:1-15. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the captured light into a first signal,	Goodman discloses or renders obvious the receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal. By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:36-48. The output of operational amplifier U1A follows two signal paths. The first path connects the raw PPG voltage signal to a unity gain buffer circuit comprised of operational amplifier U3A and resistor R18. The raw PPG voltage signal can be simultaneously monitored or utilized by system 10 (at point A in FIG. 3) as will be discussed, while the raw PPG voltage signal is further processed by the second path in the circuit to produce a conditioned PPG voltage signal (at point B in FIG. 3). The second path in the circuit (FIG. 3) connects the raw PPG voltage signal to a series of signal conditioning stages. The first conditioning stage is a ‘Sallen and Key’ high pass filter. This filter is comprised of capacitors C6 and C1, resistors R13 and R14 and operational amplifier U4A. The values of capacitors C6 and C1 and resistors R13 and R14 are chosen to provide the high pass filter with a

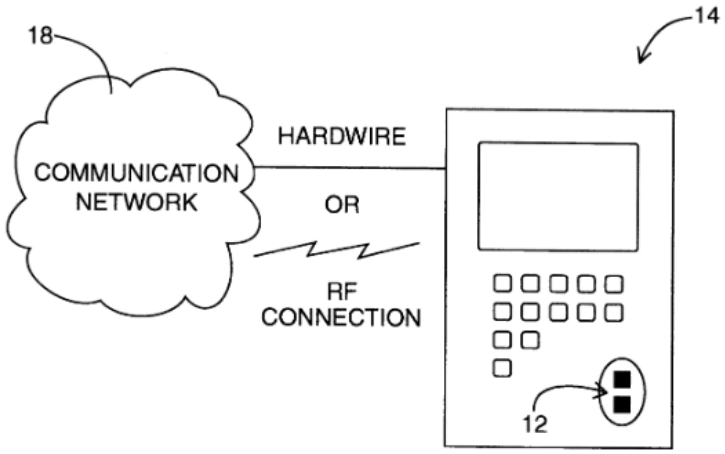
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	corner frequency of approximately 0.1 Hertz. The purpose of this filtering stage is to suppress low frequency noise within the PPG voltage signal. Goodman at 11:22-40. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Goodman discloses or renders obvious the receiver configured to: capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. PPG sensor 12 has a relatively small footprint (e.g. few Square centimeters) and is implemented using a red LED and an infrared LED, each associated with a photodiode PD and PD (FIG.3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED and LED travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. AS the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD. As is conventionally known, reflective mode PPG uses the reflected light from a Site to estimate absorption of light and to generate a raw blood Volume pulse contour Signal. Goodman at 9:57-10:5 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or

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	LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:36-48. The output of operational amplifier U1A follows two signal paths. The first path connects the raw PPG voltage signal to a unity gain buffer circuit comprised of operational amplifier U3A and resistor R18. The raw PPG voltage signal can be simultaneously monitored or utilized by system 10 (at point A in FIG. 3) as will be discussed, while the raw PPG voltage signal is further processed by the second path in the circuit to produce a conditioned PPG voltage signal (at point B in FIG. 3). The second path in the circuit (FIG. 3) connects the raw PPG voltage signal to a series of signal conditioning stages. The first conditioning stage is a ‘Sallen and Key’ high pass filter. This filter is comprised of capacitors C6 and C1, resistors R13 and R14 and operational amplifier U4A. The values of capacitors C6 and C1 and resistors R13 and R14 are chosen to provide the high pass filter with a corner frequency of approximately 0.1 Hertz. The purpose of this filtering stage is to suppress low frequency noise within the PPG voltage signal. Goodman at 11:22-40. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Goodman discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. Following this filtering process, the PPG voltage signal is applied to a combined amplifier and low pass filter stage comprised of resistors R15, R11, and R16, variable resistor VAR17, capacitor C8 and operational amplifier U2A. The gain of the amplifier is set by adjusting variable resistor VAR17. The values of resistors R16, R17 and capacitor C8 determine the corner frequency which is typically 30

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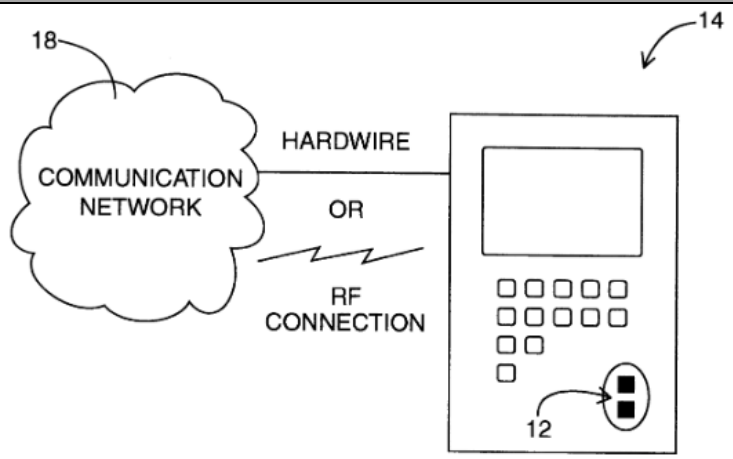
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	Hertz. The conditioned PPG voltage signal generated by this stage (at point B) is provided to the processing device 14. In this way signal conditioner module 24 improves the signal to noise ratio of the PPG signal prior to digitization. Goodman at 11:41-52. By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:36-48. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store	Goodman discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link.

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and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	 FIG. 5 Goodman at Fig.5. FIG. 5 shows another possible configuration of system 10 wherein processing device 14 is a PDA (e.g. Palm Pilot™) having PPG sensor 12 interfaced therein. PPG sensor 12 could be directly integrated into the shell of the PDA processing device 14. Alternatively, PPG sensor 12 could be implemented within a PDA accessory card or device, or adapted to interface with the PDA processing device 14 as an external wearable device. In the latter case, it would be possible for a user to wear a wearable user input device 12 such that blood volume pulse signal information could be collected by the PDA processing device 14 over the course of a day. It would be possible to arrange for periodic download of recorded volume pulse contour signal information collected by user input device 12 to processing device 14 and/or to Web site server 16 through processing device 14 over the communication network 18. Goodman at 13:26-42. Further embodiments of the invention whereby PPG sensor 12 and processing device 14 are integrated together into a single unit with a compact design are also contemplated as processing speed and device memory increase as physical dimensions decrease. For example, it is likely that PPG sensor 12 and processing device 14, and all of its associated functionality, could feasibly be incorporated into a wrist

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	watch device in the foreseeable future. It is contemplated that PPG sensor 12 could be integrated together with a computing means, wireless transmission means (e.g. well known convention radio frequency techniques as well as emerging radio frequency communication protocols such as the BlueTooth™ standard) and a battery in a small (e.g. 2 cm2) component that would adhere to a body skin area for extended periods of time (e.g. weeks) and would transmit data to a remote computing device on a continuous basis. Goodman at 13:43-58. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Goodman discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.

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	 FIG. 5 Goodman at Fig.5. FIG. 5 shows another possible configuration of system 10 wherein processing device 14 is a PDA (e.g. Palm Pilot™) having PPG sensor 12 interfaced therein. PPG sensor 12 could be directly integrated into the shell of the PDA processing device 14. Alternatively, PPG sensor 12 could be implemented within a PDA accessory card or device, or adapted to interface with the PDA processing device 14 as an external wearable device. In the latter case, it would be possible for a user to wear a wearable user input device 12 such that blood volume pulse signal information could be collected by the PDA processing device 14 over the course of a day. It would be possible to arrange for periodic download of recorded volume pulse contour signal information collected by user input device 12 to processing device 14 and/or to Web site server 16 through processing device 14 over the communication network 18. Goodman at 13:26-42. Preferably the communication protocol used with the invention would be TCP/IP. Those skilled in the art will understand the manner in which the data is formatted by processing device 14 prior to being transmitted over communication network 18 to Web server 16. TCP/IP then parses the data into packets, each packet including a field indicating the destination Web site 16. Processing device 14 then outputs the packets onto communication network 18. At minimum, the packets will contain data relating to the identity of the user and an indication of the type of measurement data being is encoded within the data

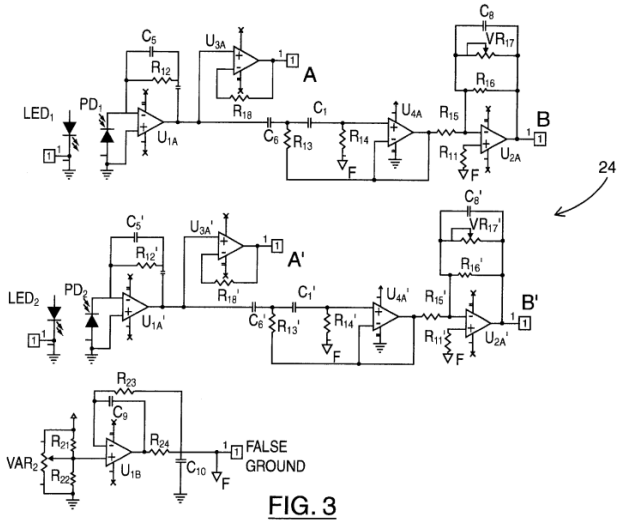
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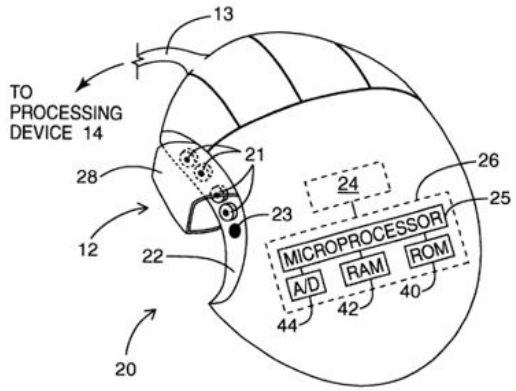
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	message. Optionally, other types of information could be provided such as the time and date of the measurement and the type of medical device which took the measurement. Goodman at 33:61-34:7. Further embodiments of the invention whereby PPG 16 would provide users with additional functionality for analysis, storage, and retrieval of physiological signals that they convey to the Web site. All communication of physiological data would be encrypted in a secure fashion to preserve privacy (350). The user would have the ability to store their physiological data (352) as well as text based data (354) in a personal database with access to the user in a password protected secure fashion. The medical data file maintained for the user at the Web site may be periodically updated to reflect received measurement data. Specifically, the ability of system 10 described above to recognize each individual user through the unique nature of their volume pulse contour adds an additional level of security to system 10 by establishing a database of physiological fingerprints. Goodman at 34:8-22. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Goodman discloses or renders obvious the measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. In this way, only authorized persons would only be allowed access to resources, locations, on the basis of their particular aortic reflected wave characteristics. It is contemplated that an appropriately designed matching program would be used to compare stored aortic reflected wave profile with an aortic reflected

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	wave that is extracted from a PPG signal obtained from the user using the PPG sensor 12 of system 10 described above. It should be noted that such a security system would have to periodically update the store aortic reflected wave profiles (e.g. every 6 months), as the aortic reflected wave profile of a user will change significantly with age. Goodman at 35:25-36. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Goodman discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. In this way, only authorized persons would only be allowed access to resources, locations, on the basis of their particular aortic reflected wave characteristics. It is contemplated that an appropriately designed matching program would be used to compare stored aortic reflected wave profile with an aortic reflected wave that is extracted from a PPG signal obtained from the user using the PPG sensor 12 of system 10 described above. It should be noted that such a security system would have to periodically update the store aortic reflected wave profiles (e.g. every 6 months), as the aortic reflected wave profile of a user will change significantly with age. Goodman at 35:25-36. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it

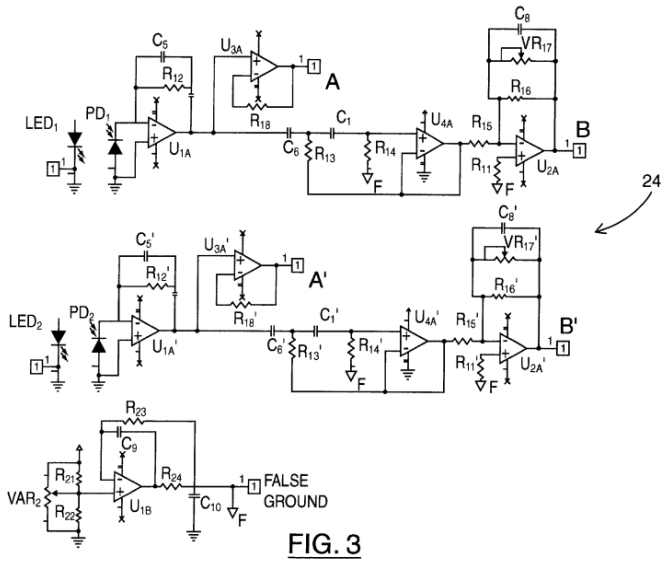
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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Goodman discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.  FIG. 3 Goodman at Fig.3. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light.

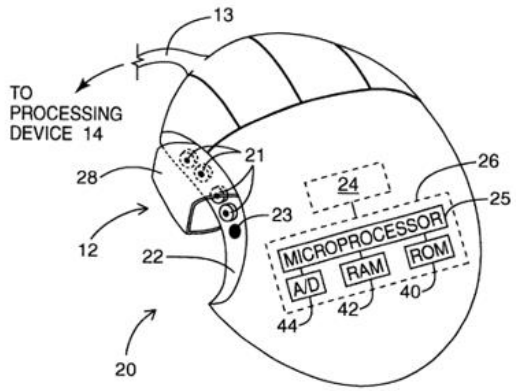
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	Goodman at 9:57-10:5. Following this filtering process, the PPG voltage signal is applied to a combined amplifier and low pass filter stage comprised of resistors R15, R11, and R16, variable resistor VAR17, capacitor C8 and operational amplifier U2A. The gain of the amplifier is set by adjusting variable resistor VAR17. The values of resistors R16, R17 and capacitor C8 determine the corner frequency which is typically 30 Hertz. The conditioned PPG voltage signal generated by this stage (at point B) is provided to the processing device 14. In this way signal conditioner module 24 improves the signal to noise ratio of the PPG signal prior to digitization. Goodman at 11:41-52.  FIG. 2 Goodman at Fig. 2. “Microcontroller 26 is also programmed to control the operation of LED1 and LED2 of PPG sensor 12 for optimal sensor operation. Microcontroller 26 is programmed to generate digital switching pulses to drive LED1 and LED2 of PPG sensor 12 alternately at a repetition rate of 1 KHz (i.e. each LED accomplishes sampling at a rate of 1 KHz). It has been determined that the sampling frequency should be 10 times the highest frequency of interest. The conditioned PPG signal has frequency components as high as 30 Hertz. However, 60 Hertz noise from electrical sources in the environment necessitates

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	sampling of the signal at a high enough rate to ensure the effectiveness of the associated noise filtering software of CPU 5. By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary.” Goodman at 12:12-48. In this way, only authorized persons would only be allowed access to resources, locations, on the basis of their particular aortic reflected wave characteristics. It is contemplated that an appropriately designed matching program would be used to compare stored aortic reflected wave profile with an aortic reflected wave that is extracted from a PPG signal obtained from the user using the PPG sensor 12 of system 10 described above. It should be noted that such a security system would have to periodically update the store aortic reflected wave profiles (e.g. every 6 months), as the aortic reflected wave profile of a user will change significantly with age. Goodman at 35:25-36. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the	Goodman discloses or renders obvious the measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.

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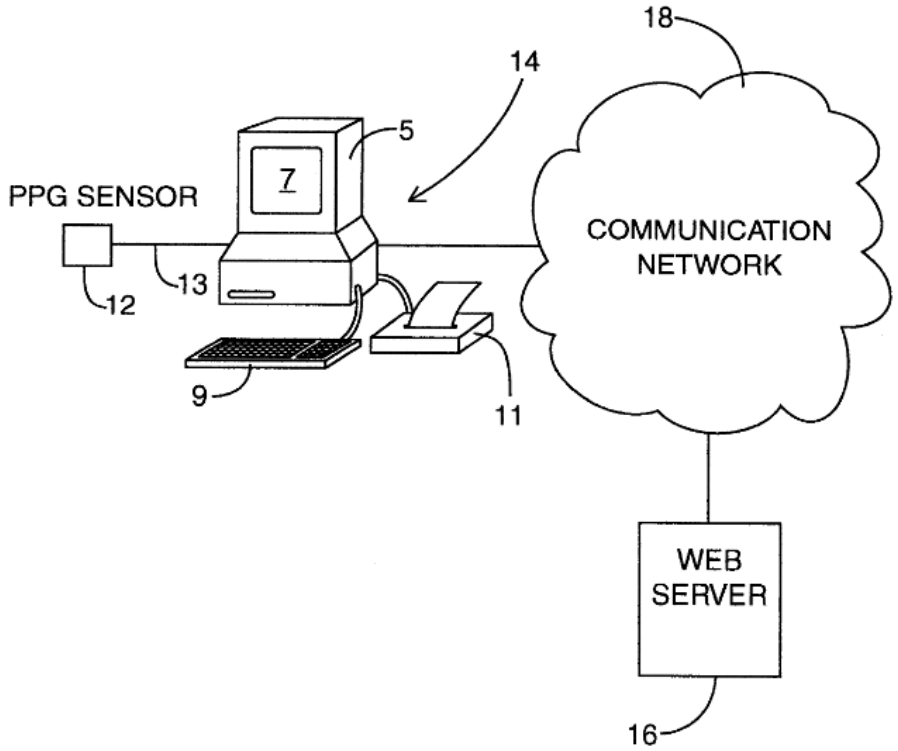
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signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	*See* claim 12 above.  FIG. 3 Goodman at Fig.3. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 9:57-10:5.

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	Following this filtering process, the PPG voltage signal is applied to a combined amplifier and low pass filter stage comprised of resistors R15, R11, and R16, variable resistor VAR17, capacitor C8 and operational amplifier U2A. The gain of the amplifier is set by adjusting variable resistor VAR17. The values of resistors R16, R17 and capacitor C8 determine the corner frequency which is typically 30 Hertz. The conditioned PPG voltage signal generated by this stage (at point B) is provided to the processing device 14. In this way signal conditioner module 24 improves the signal to noise ratio of the PPG signal prior to digitization. Goodman at 11:41-52.  FIG. 2 Goodman at Fig. 2. “Microcontroller 26 is also programmed to control the operation of LED1 and LED2 of PPG sensor 12 for optimal sensor operation. Microcontroller 26 is programmed to generate digital switching pulses to drive LED1 and LED2 of PPG sensor 12 alternately at a repetition rate of 1 KHz (i.e. each LED accomplishes sampling at a rate of 1 KHz). It has been determined that the sampling frequency should be 10 times the highest frequency of interest. The conditioned PPG signal has frequency components as high as 30 Hertz. However, 60 Hertz noise from electrical sources in the environment necessitates sampling of the signal at a high enough rate to ensure the effectiveness of the associated noise filtering software of CPU 5. By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and

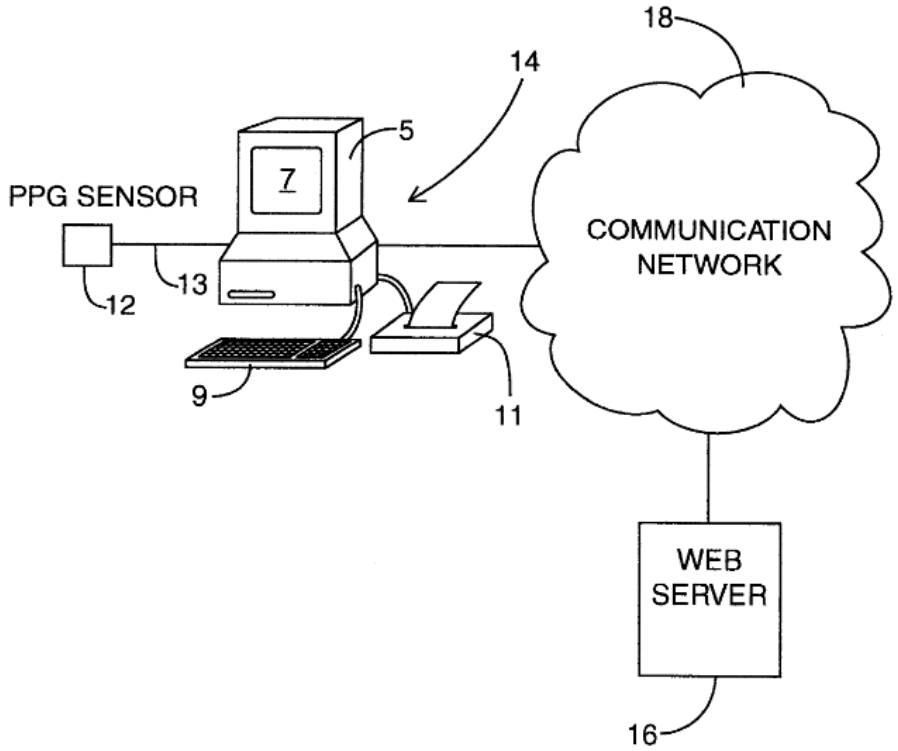
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	LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary.” Goodman at 12:12-48. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam	Goodman discloses or renders obvious the measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above.

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reflected or transmitted from the sample.	 Goodman at Fig.1. Reference is first made to FIG. 1, which shows the overall configuration of the preferred embodiment of a physiological monitoring system 10, according to the present invention. System 10 comprises a conventional plethysmography (PPG) sensor 12 coupled to a processing device 14 which is in data communication with a Web site server 16 through a communication network 18 (i.e. the Internet). PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse or some other computer peripheral (e.g. keyboard, touchpad, joystick) commonly associated with a computer processing device 14. It should be understood that it would be also possible to implement the invention by incorporating PPG sensor 12 within the casing of a personal digital assistant (PDA) or within some other type of stand alone data processing and transmitting device (e.g. a watch) or simply as a stand alone sensor device.

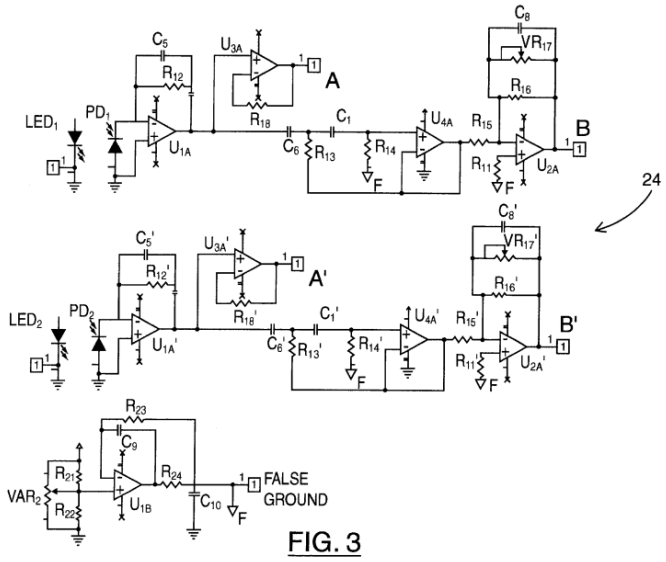
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	PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 9:57-10:5.

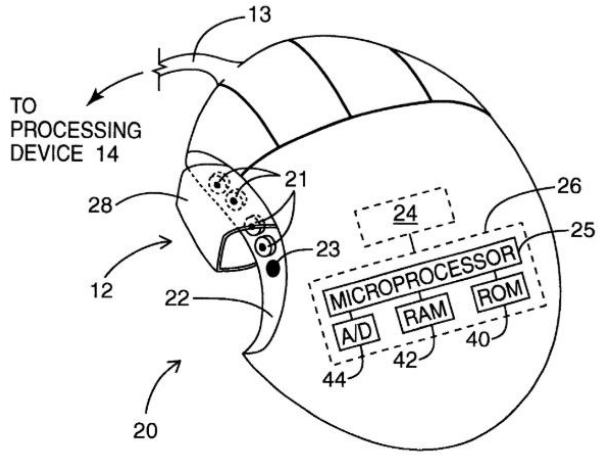
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’304 Patent	Goodman
	 Goodman at Fig.1. Reference is first made to FIG. 1, which shows the overall configuration of the preferred embodiment of a physiological monitoring system 10, according to the present invention. System 10 comprises a conventional plethysmography (PPG) sensor 12 coupled to a processing device 14 which is in data communication with a Web site server 16 through a communication network 18 (i.e. the Internet). PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse or some other computer peripheral (e.g. keyboard, touchpad, joystick) commonly associated with a computer processing device 14. It should be understood that it would be also possible to implement the invention by incorporating PPG sensor 12 within the casing of a personal digital assistant (PDA) or within some other type of stand alone data processing and transmitting device (e.g. a watch) or simply as a stand alone sensor device.

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	PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 9:57-10:5. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Goodman discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above.

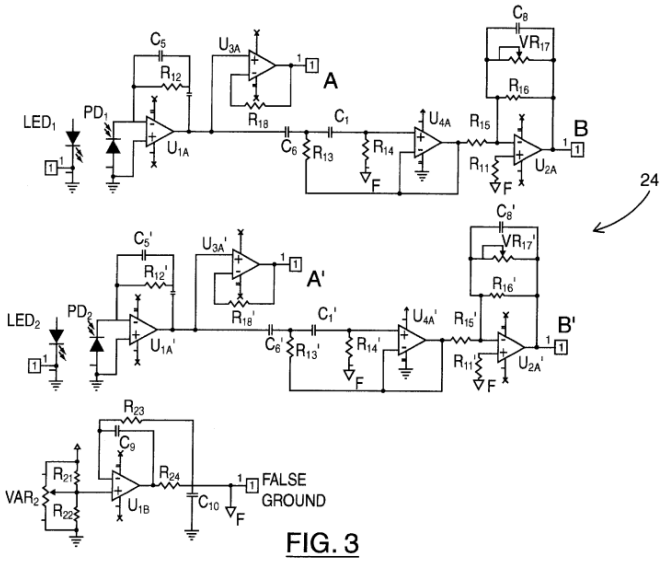
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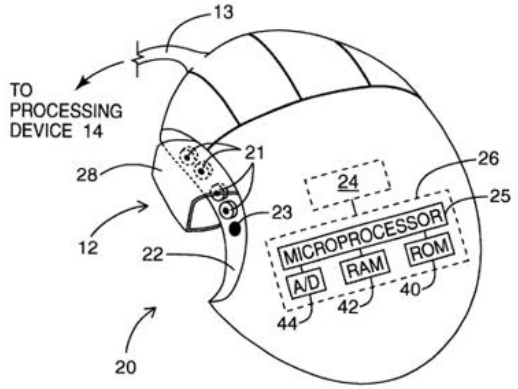
’304 Patent	Goodman
	 FIG. 3 Goodman at Fig.3. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 9:57-10:5.

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	 Goodman at Fig. 2. Accordingly, the PPG voltage signal from photodiodes PD1 and PD2 is converted into conditioned PPG voltage signals at outputs at nodes B and B′, respectively. These conditioned PPG voltage signals are provided to microcontroller 26 for digitizing and analysis. Microcontroller 26 (FIG. 2) may be any commercially available programmable device such as a Mitsubishi USB microcontroller (available from Mitsubishi Semiconductors, Inc. of Japan), although it should be understood that any type of logic circuit with similar operating functions (particularly one which has a USB interface and which includes an on-board analog-to-digital converter) can be utilized. Storage of program instructions and other static data is provided by a read only memory (ROM) 40, while storage of dynamic data is provided by a random access memory (RAM) 42. Both memory units 40 and 42 are controlled and accessed by microprocessor 25. On board analog-to-digital converter A/D 44 (10 bit, 5 channel input) is used to convert the conditioned PPG signals at B and B′ into time sampled digital signals which are then provided to processing device 14. Also, all of the circuitry of signal conditioner module 24 is provided with a 5 volt source from the USB line of microcontroller 26. Goodman at 11:66-12: 21. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Goodman discloses or renders obvious the measurement system of claim 15, wherein the first arc and the second arc are concentric. *See* claim 15 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Goodman discloses or renders obvious a wearable device for use with a smart phone or tablet, the wearable device. *See* 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of	Goodman discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters.

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semiconductor sources for measuring one or more physiological parameters,	*See* above at claim 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Goodman discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths.  FIG. 3 Goodman at Fig.3. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of

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	light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 9:57-10:5. Following this filtering process, the PPG voltage signal is applied to a combined amplifier and low pass filter stage comprised of resistors R15, R11, and R16, variable resistor VAR17, capacitor C8 and operational amplifier U2A. The gain of the amplifier is set by adjusting variable resistor VAR17. The values of resistors R16, R17 and capacitor C8 determine the corner frequency which is typically 30 Hertz. The conditioned PPG voltage signal generated by this stage (at point B) is provided to the processing device 14. In this way signal conditioner module 24 improves the signal to noise ratio of the PPG signal prior to digitization. Goodman at 11:41-52.  FIG. 2

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	Goodman at Fig. 2. “Microcontroller 26 is also programmed to control the operation of LED1 and LED2 of PPG sensor 12 for optimal sensor operation. Microcontroller 26 is programmed to generate digital switching pulses to drive LED1 and LED2 of PPG sensor 12 alternately at a repetition rate of 1 KHz (i.e. each LED accomplishes sampling at a rate of 1 KHz). It has been determined that the sampling frequency should be 10 times the highest frequency of interest. The conditioned PPG signal has frequency components as high as 30 Hertz. However, 60 Hertz noise from electrical sources in the environment necessitates sampling of the signal at a high enough rate to ensure the effectiveness of the associated noise filtering software of CPU 5. By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary.” Goodman at 12:12-48. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Goodman discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a].

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;	Goodman discloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue; *See* 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Goodman discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Goodman discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Goodman discloses or renders obvious the measurement device configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[a], 11[b], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Goodman discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Goodman discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link.	Goodman discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to	Goodman discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue

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further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claims 19, 13 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Goodman discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claims 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Goodman discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claims 16, 21 above.

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EXHIBIT D3

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D4

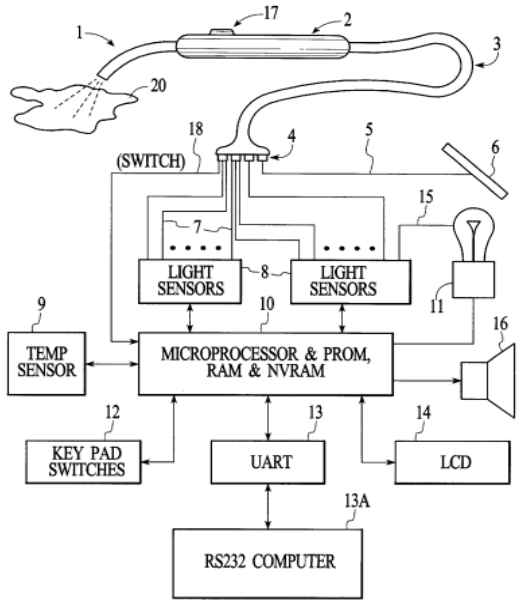
U.S. Pat. No. 10,874,304 in view of US Patent No 6,519,037 to Wayne D. Jung at el. ("Jung")

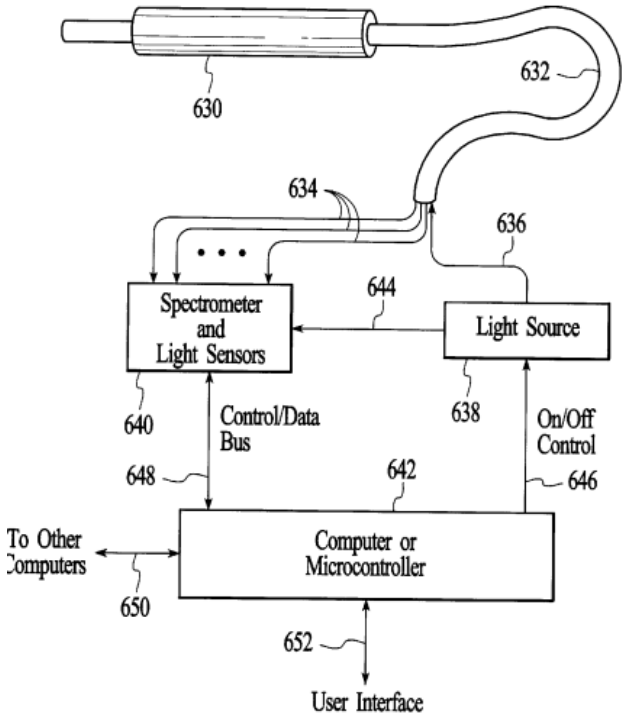
As described in detail below, Jung (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D3 and D5-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. . This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Jung. The cited portions of Jung are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Jung. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Jung "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Jung does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Jung (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Jung anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 11	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Jung discloses or renders obvious a measurement system.  FIG. 1 Jung at Fig. 1.

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	 FIG. 39 Jung at Fig. 39. With reference to FIG. 1, an exemplary preferred embodiment of a color/optical characteristic measuring system and method in accordance with the present invention will be described. It should be noted that, at various places herein, such a color measuring system is sometimes referred to as an intraoral reflectometer, etc. Jung at 8:41-46

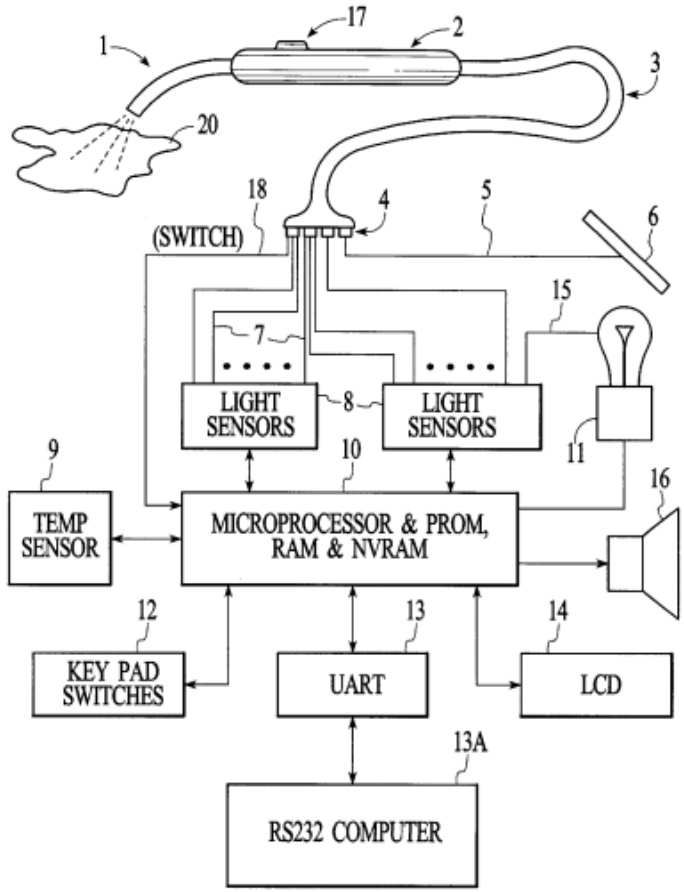
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	Probe tip 1 encloses a plurality of fiber optics, each of which may constitute one or more fiber optic fibers. In a preferred embodiment, the fiber optics contained within probe tip 1 includes a single light source fiber optic and a number of groups of light receiver fiber optics. The use of such fiber optics to measure the color or other optical characteristics of an object will be described later herein. Probe tip 1 is attached to probe body 2, on which is fixed switch 17. Switch 17 communicates with microprocessor 10 through wire 18 and provides, for example, a mechanism by which an operator may activate the device in order to make a color/optical measurement. Fiber optics within probe tip 1 terminate at the forward end thereof (i.e., the end away from probe body 2). The forward end of probe tip 1 is directed towards the surface of the object to be measured as described more fully below. The fiber optics within probe tip 1 optically extend through probe body 2 and through fiber optic cable 3 to light sensors 8, which are coupled to microprocessor 10. Jung at 8:47-65. It should be noted that microprocessor 10 includes conventional associated components, such as memory (programmable memory, such as PROM, EPROM or EEPROM; working memory such as DRAMs or SRAMs; and/or other types of memory such as non-volatile memory, such as FLASH), peripheral circuits, clocks and power supplies, although for clarity such components are not explicitly shown. Other types of computing devices (such as other microprocessor systems, programmable logic arrays or the like) are used in other embodiments of the present invention. Jung at 8:66-9:9. Light source 11 in the preferred embodiment is a halogen light source (of, for example, 5-100 watts, with the particular wattage chosen for the particular application), which may be under the control of microprocessor 10. The light from light source 11 reflects from cold mirror 6 and into source fiber optic 5. Source fiber optic 5 passes through to the forward end of probe tip 1 and provides the light stimulus used for purposes of making the measurements described herein. Cold mirror 6 reflects visible light and passes infra-red light, and is used to reduce the amount of infra-red light produced by light source 11 before the light is introduced into source fiber optic 5. Such infra-red light reduction of the light from a halogen source such as light source 11 can help prevent saturation of the receiving light sensors, which can reduce overall system sensitivity. Fiber 15 receives light directly from light source 11 and passes through to light sensors 8 (which may be through a neutral density filter). Microprocessor 10 monitors the light output of light source 11 through fiber 15, and thus may monitor and, if necessary compensate

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	for, drift of the output of light source 11. In certain embodiments, microprocessor 10 also may sound an alarm (such as through speaker 16) or otherwise provide some indication if abnormal or other undesired performance of light source 11 is detected. The data output from light sensors 8 pass to microprocessor 10. Microprocessor 10 processes the data from light sensors 8 to produce a measurement of color and/or other characteristics. Microprocessor 10 also is coupled to key pad switches 12, which serve as an input device. Through key pad switches 12, the operator may input control information or commands, or information relating to the object being measured or the like. In general, key pad switches 12, or other suitable data input devices (such as push button, toggle, membrane or other switches or the like), serve as a mechanism to input desired information to microprocessor 10. Jung at 9:49-10:17. Computer 642 may be a conventional computer such as a PC or microcontroller or other processing device, and preferably is coupled to a user interface (e.g., display, control switches, keyboard, etc.), which is generically illustrated in FIG. 39 by interface 652. Optionally, computer 642 is coupled to other computing devices, such as may be used for data processing, manipulation, storage or further display, through interface 650. Computer 642 preferably includes the typical components such as (but not limited to) a CPU, random access or other memory, non-volatile memory/storage for storing program code, and may include interfaces for the user such as display, audio generators, keyboard or keypad or touch screen or mouse or other user input device (which may be through interface 652), and optionally interfaces to other computers such as parallel or serial interfaces (which may be through interface 650). Computer 642 interfaces to spectrometer/light sensors 640 for control of the spectrometer and overall system and to receive light intensity and light spectrum data from spectrometer/light sensors 640. In a preferred embodiment, control/data bus 648 for interfacing to spectrometer/light sensors 640 is a standard 25 pin bi-directional parallel port. In certain embodiments, computer 642 may be separate, standalone and/or detachable from spectrometer/light sensors 640 and may be a conventional laptop, notebook or other portable or handheld-type personal computer. In other embodiments, computer 642 may be an integral part of the system contained in one or more enclosure(s), and may be an embedded personal computer or other type of integrated computer. Purposes of computer 642 preferably include controlling light source 638 and spectrometer/light sensors 640, receiving light intensity and spectral or other data output from spectrometer/light sensors 640, analyzing received or other data and determining the optical

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	properties of the object or material, and displaying or outputting data to a user or other computing device or data gathering system. Jung at 52:17-53. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Jung discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths.

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	 FIG. 1 Jung at Fig. 1. A handheld probe is utilized in the present invention, with the handheld probe containing a number of fiber optics in certain preferred embodiments. Light is directed from one (or more) light source(s) towards the object/tooth to be measured, which in certain preferred embodiments is a central light source fiber optic (other light sources and light source arrangements also may be utilized).

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	Jung at 4:7-13. Probe tip 1 encloses a plurality of fiber optics, each of which may constitute one or more fiber optic fibers. In a preferred embodiment, the fiber optics contained within probe tip 1 includes a single light source fiber optic and a number of groups of light receiver fiber optics. The use of such fiber optics to measure the color or other optical characteristics of an object will be described later herein. Probe tip 1 is attached to probe body 2, on which is fixed switch 17. Switch 17 communicates with microprocessor 10 through wire 18 and provides, for example, a mechanism by which an operator may activate the device in order to make a color/optical measurement. Fiber optics within probe tip 1 terminate at the forward end thereof (i.e., the end away from probe body 2). The forward end of probe tip 1 is directed towards the surface of the object to be measured as described more fully below. The fiber optics within probe tip 1 optically extend through probe body 2 and through fiber optic cable 3 to light sensors 8, which are coupled to microprocessor 10. Jung at 8:47-65. It is known that certain objects such as human teeth may fluoresce, and such optical characteristics also may be measured in accordance with the present invention. A light source with an ultraviolet component may be used to produce more accurate color/optical data with respect to such objects. Such data may be utilized to adjust the amounts and or proportions or types of dental fluorescing materials in dental restorations or prosthesis. In certain embodiments, a tungsten/halogen source (such as used in a preferred embodiment) may be combined with a UV light source (such as a mercury vapor, xenon or other fluorescent light source, etc.) to produce a light output capable of causing the object to fluoresce. Alternately, a separate UV light source, combined with a visible-light-blocking filter, may be used to illuminate the object. Such a UV light source may be combined with light from a red LED (for example) in order to provide a visual indication of when the UV light is on and also to serve as an aid for the directional positioning of the probe operating with such a light source. A second measurement may be taken using the UV light source in a manner analogous to that described earlier, with the band of the red LED or other supplemental light source being ignored. The second measurement may thus be used to produce an indication of the fluorescence of the tooth or other object being measured. With such a UV light source, a silica fiber optic (or other suitable material) typically would be required to transmit the light to the object (standard fiber optic materials such as glass and plastic in general do not propagate UV light in a desired manner, etc.).

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	Jung at 15:33-61. The material of positioning device 282 is formed in a manner to fit on/over tooth 280 (such as over the incisal edge of tooth 280 and/or over one or more adjacent teeth) so that it may be placed on/over tooth 280 in a repeatable manner. Such a positioning device may serve to ensure that the desired area of tooth 280 is measured, and also allows for repeat measurements of the same area for purposes of confirmation, fluorescence measurement, or other optical measurement, or the like. Jung at 28:46-55. Referring again to FIG. 41A, light source 638 may be coupled to certain of sensors 676 through light path 674. Light bias, such as previously described, may be provided from the light source, or alternatively, from separately provided LED 680, which may couple light to certain of sensors 676 for providing controllable light bias to sensors 676 through light conduit 678. Jung at 53:65-54:4. In preferred embodiments utilizing this aspect of the present invention, the three monochromatic light source fibers are each supplied with monochromatic light of different wavelengths. One preferred way to provide such monochromatic light is by utilizing three infra-red LEDs of different wavelengths, for example, or by filtering a white light source with interference notch filters with different center wavelengths. Jung at 66:58-65. In one such preferred embodiment, a broad band white light source supplies light to all light source fibers/light guides. Light supplied to the three monochromatic light sources is filtered with narrow band pass notch filters with center wavelengths greater than 700 nanometers. For example, one center wavelength may be 750 nanometers, while another center wavelength may be 775 nanometers, and a third center wavelength may be 800 nanometers. It should be noted that the exact filter wavelengths are not important; it is only important that such wavelengths be sufficiently different so that they do not overlap and may be separately detected, as described herein. The other two rings of light sources include, for example, a broad-band visible range filter that passes light from 400 to 700 nanometers and rejects light in the range of the three monochrome filters. What is important is the broad-band light sources

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	preferably do not emit light in the frequency range of the monochromatic light sources, or at least do not emit light in such frequency range to a degree that would interfere with the detection of the monochromatic light as described herein. Jung at 66:66-67:17. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Jung discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. FIGS. 8A and 8B illustrate another embodiment of a removable probe tip that may be used to reduce contamination in accordance with the present invention. As illustrated in FIG. 8A, probe tip 88 is removable, and includes four (or a different number, depending upon the application) fiber optic connectors 90, which are positioned within optical guard 92 coupled to connector 94. Optical guard 92 serves to prevent “cross talk” between adjacent fiber optics. As illustrated in FIG. 8B, in this embodiment removable tip 88 is secured in probe tip housing 93 by way of spring clip 96 (other removable retaining implements are utilized in other embodiments). Probe tip housing 93 may be secured to base connector 95 by a screw or other conventional fitting. It should be noted that, with this embodiment, different size tips may be provided for different applications, and that an initial step of the process may be to install the properly-sized (or fitted tip) for the particular application. Removable tip 88 also may be sterilized in a typical autoclave, hot steam, chemiclave or other sterilizing system, or disposed of. In addition, the entire probe tip assembly is constructed so that it may be readily disassembled for cleaning or repair. In certain embodiments the light source/receiver elements of the removable tip are constructed of glass, silica or similar materials, thereby making them particularly suitable for autoclave or similar high temperature/pressure cleaning methods, which in certain other embodiments the light source/receiver

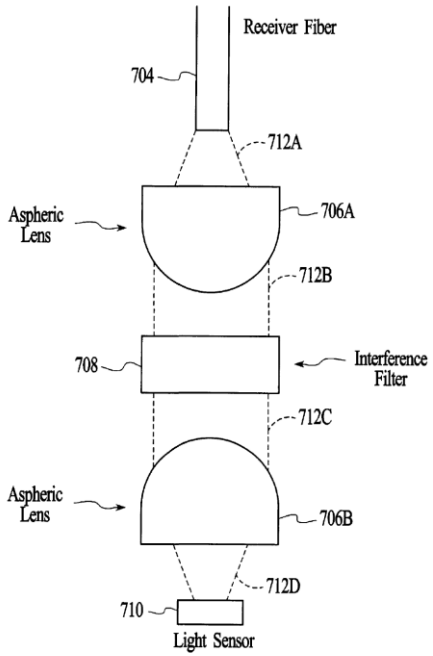
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	elements of the removable tip are constructed of plastic or other similar materials, which may be of lower cost, thereby making them particularly suitable for disposable-type removable tips, etc. Jung at 22:12-42. In general, the aperture of the fiber optics used in light conduit 340 may be chosen to match the aperture of the fiber optics for the light source and the light receivers or alternately the light conduit aperture could be greater than or equal to the largest source or receiver aperture. Thus, the central part of the light conduit may conduct light from the light source and illuminate the surface as if it constituted a single fiber within a bundle of fibers. Similarly, the outer portion of the light conduit may receive reflected light and conduct it to light receiver fiber optics as if it constituted single fibers. Light conduit 340 has ends that preferably are highly polished and cut perpendicular, particularly the end coupling light to fiber optics 346. Similarly, the end of fiber optics 346 abutting light conduit 340 also is highly polished and cut perpendicular to a high degree of accuracy in order to minimize light reflection and cross talk between the light source fiber optic and the light receiver fiber optics and between adjacent receiver fiber optics. Light conduit 340 offers significant advantages including in the manufacture and installation of such a removable tip. For example, the probe tip need not be particularly aligned with the probe tip holder; rather, it only needs to be held against the probe tip holder such as with a compression mechanism (such as with compression jaws 342) so as to couple light effectively to/from fiber optics 346. Thus, such a removable tip mechanism may be implemented without alignment tabs or the like, thereby facilitating easy installation of the removable probe tip. Such an easy installable probe tip may thus be removed and cleaned prior to installation, thereby facilitating use of the color/optical measuring apparatus by dentists, medical professions or others working in an environment in which contamination may be a concern. Light conduit 340 also may be implemented, for example, as a small section of light conduit, which may facilitate easy and low cost mass production and the like. Jung at 23:10-44. In certain situations, a long time may be required for the light source and for the light bias source to stabilize. In other situations, the light source and bias source may drift. In preferred embodiments, the light source is a 18 W, 3300 K halogen stabilized tungsten filament lamp manufactured by Welch Allyn, Inc. The light bias preferably is provided by a high intensity LED and a fiber optic light guide or conduit (see LED 680 and light conduit 678 of FIG. 41A) that passes to each biased sensor of sensors 676. The intensity of LED 680 preferably is controlled and varied with high frequency pulse width modulation, or

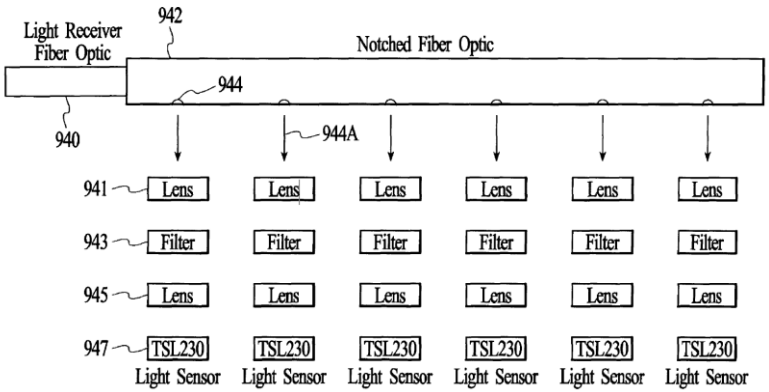
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	by analog constant current controllers. By controlling the intensity of bias LED 680, the bias light level can be varied to best match the sensor sampling rate. Jung at 56:34-47. Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise. Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The three monochrome sources, however, are turned on and off rapidly, synchronous with the spectral measurements being taken at, for example, a rate of 1000 Hz. The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations. Jung at 68:13-32. In accordance with such embodiments, each interference filter is positioned above an electro-optical sensor. In certain preferred embodiments, the sensors are light to frequency converter sensors, such as those manufactured by Texas Advanced Optical Systems (formerly Texas Instruments). Without being bound by theory, such sensing elements will now be further described. The light to frequency converter sensors generally are an array of photo diodes 1.25 mm square. There are 100 or other number of photo diodes in each array. Thus 100 (or other number) photo diodes serve as sensors for each interference filter providing high sensitivity and low electrical noise. Such light to frequency converters have a PWM (pulse width modulation) TTL compatible digital signal output. They produce a PWM signal whose frequency is directly proportional to the intensity of the input light. Since the light incident upon each light to frequency converter is notch filtered by its corresponding interference filter, its output represents the integral intensity of a portion of the optical spectrum. The combined output of all sensors is an abridged optical spectrum. Jung at 93:20-39.

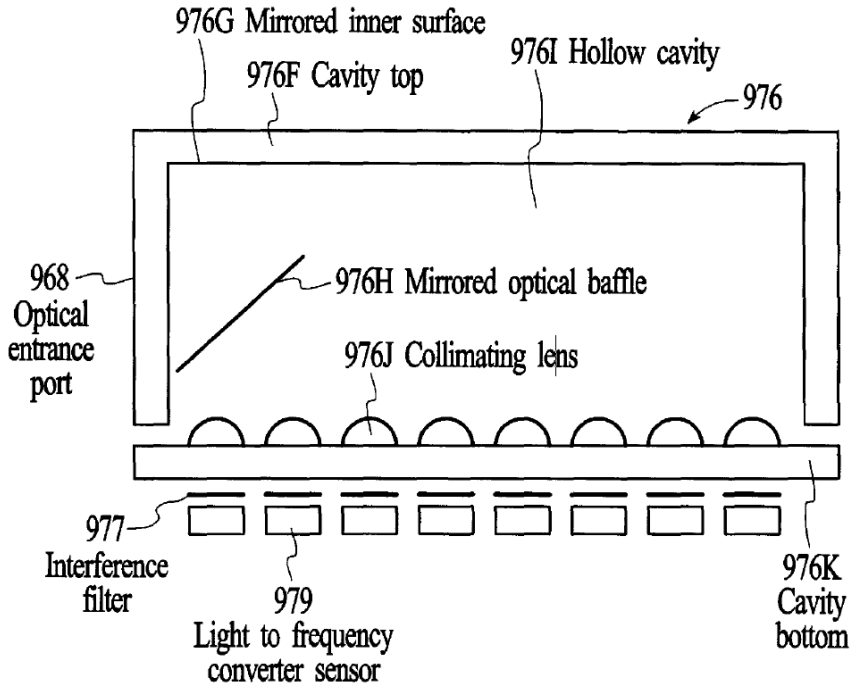
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Jung discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample.  FIG. 44 Jung at Fig. 44

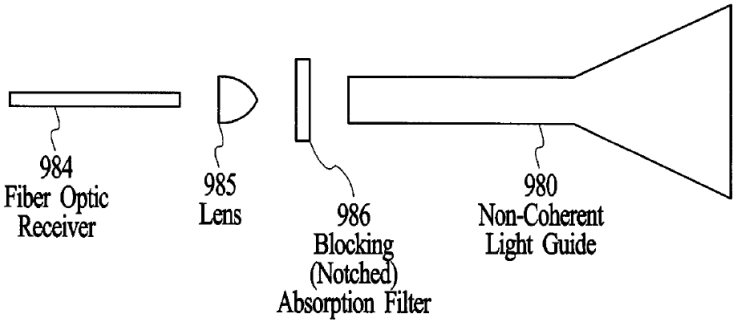
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	 FIG. 63 Jung at Fig. 63.

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	 Optical Manifold with Collimating Lenses and Hollow Cavity and Baffle FIG. 79 Jung at Fig 79.

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	 Round to Line Non-Coherent Light Guide with Lens and Absorption Filters FIG. 83 Jung at Fig. 83. In the embodiment of FIG. 1, the fiber optics from fiber optic cable 3 end at splicing connector 4. From splicing connector 4, each or some of the receiver fiber optics used in this embodiment is/are spliced into a number of smaller fiber optics (generally denoted as fibers 7), which in this embodiment are fibers of equal diameter, but which in other preferred embodiments may be of unequal diameter and/or numeric aperture (NA) (including, for example, larger or smaller “height/angle” or perimeter fibers, as more fully described herein). One of the fibers of each group of fibers may pass to light sensors 8 through a neutral density filter (as more fully described with reference to FIG. 3), and collectively such neutrally filtered fibers may be utilized for purposes of height/angle determination, translucency determination and gloss determination (and also may be utilized to measure other surface characteristics, as more fully described herein). Remaining fibers of each group of fibers may pass to light sensors 8 through color filters and may be used to make color/optical measurements. In still other embodiments, splicing connector 4 is not used, and fiber bundles of, for example, five or more fibers each extend from light sensors 8 to the forward end of probe tip 1. In certain embodiments, unused fibers or other materials may be included as part of a bundle of fibers for purposes of, for example, easing the manufacturing process for the fiber bundle. What should be noted is that, for purposes of the present invention, a plurality of light receiver

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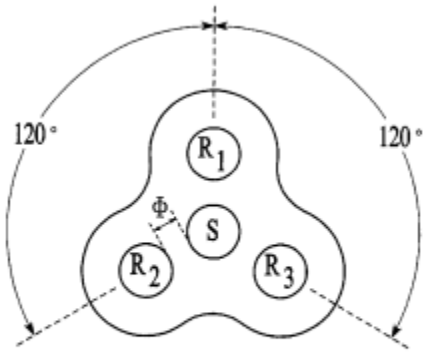
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	fiber optics or elements (such as fibers 7) are presented to light sensors 8, with the light from the light receiver fiber optics/elements presenting light reflected from object 20. While the various embodiments described herein present tradeoffs and benefits that may not have been apparent prior to the present invention (and thus may be independently novel), what is important for the present discussion is that light from fiber optics/elements at the forward end of probe tip 1 is presented to sensors 8 for color/optical measurements and angle/height determination, etc. In particular, fiber optic configurations of certain preferred embodiments will be explained in more detail hereinafter. Jung at 9:10-15. With reference to FIG. 3, a partial arrangement of light receiver fiber optics and sensors that may be used in a preferred embodiment of the present invention will now be described. Fibers 7 represent light receiving fiber optics, which transmit light reflected from the object being measured to light sensors 8. In an exemplary embodiment, sixteen sensors (two sets of eight) are utilized, although for ease of discussion only 8 are illustrated in FIG. 3 (in this preferred embodiment, the circuitry of FIG. 3 is duplicated, for example, in order to result in sixteen sensors). In other embodiments, other numbers of sensors are utilized in accordance with the present invention. Jung at 12:22-33. In yet another illustrative example, an assessment or prediction of the characteristics of an underlying material, such as the pulpal tissue within a tooth may be made. Such capabilities may be further enhanced by comparisons with measurements taken of the object at an earlier time, such as data taken of the tooth or other object at one or more earlier points in time. Such comparisons based on such historical data and/or stored data may allow highly useful assessments or predictions of the current or projected condition or status of the tooth, tissue or other object, etc. Many other industrial uses of such surface and subsurface assessment/prediction capabilities are possible. Jung at 14:56-67. The same principle generally is true for a fiber optic being utilized as a receiver. Consider mounting a light sensor on one end of a fiber optic and holding the other end near an illuminated surface. The fiber optic can only propagate light without loss when the light entering the fiber optic is incident on the end

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	of the fiber optic near the surface if the light enters the fiber optic within its acceptance angle phi. A fiber optic utilized as a light receiver near a surface will only accept and propagate light from the circular area of radius r on the surface. As the fiber optic is raised from the surface, the area increases. As the fiber optic is lowered to the surface, the area decreases. Jung at 15:39-50. Light conduit 340 in this embodiment serves to conduct light from the light source to the surface of the object being measured, and also to receive reflected light from the surface and conduct it to light receiver fiber optics 346 in probe handle 344. Light conduit 340 is held in position with respect to fiber optics 346 by way or compression jaws 342 or other suitable fitting or coupled that reliably positions light conduit 340 so as to couple light effectively to/from fiber optics 346. Fiber optics 346 may be separated into separate fibers/light conduits 348, which may be coupled to appropriate light sensors, etc., as with previously described embodiments. Jung at 22:65-23:9. As illustrated in FIG. 44, the cone of light produced by exemplary fiber optic 704 (illustrated by lines 712A) preferably is collimated with first aspheric lens (or fresnel lens) 706A (illustrated by lines 712B) prior to entering interference filter 708. Light emitted from filter 708 (illustrated by lines 712C) is "gathered" by second aspheric lens (or fresnel lens) 706B to concentrate (illustrated by lines 712D) as much light as possible on light sensor 710. In accordance with such embodiments, filters, particularly interference-type filters, may more optimally be utilized in a manner to reduce such bandwidth spreading or other undesirable effects. Jung at 55:26-37. As illustrated in FIG. 63, light exiting from notches/ports 944 may be coupled to light sensors 947. In the illustrated preferred embodiment, the light is coupled to sensors 947 through lens 941, filter 943 and lens 945. Filters 943 can be cut-off, interference or other filters as described elsewhere herein (e.g., to cover a desired spectral band or bands, and may include neutral density filters, etc.). Lens 941 and 945 preferably constitute GRIN lens and/or other lens of a type to assist in collimating or otherwise directing light from notches/ports 944 to sensors 947. As will be understood from description elsewhere herein, certain sensors may receive light without filters or through separate receivers (e.g., sensors for determining height or angle, etc.).

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	Jung at 80:12-24. FIG. 79 illustrates optical manifold 976, that may include lenses similar to the manifold illustrated in FIG. 78. The embodiment illustrated in FIG. 79, however, preferably is constructed of two parts. A first part 976F defines optical cavity 9761 with entrance port 968 at one side that is hollow and that is mirrored on the interior (see, e.g., mirrored inner surface 976G). Cavity 9761, generally, tends to act as a miniature integrating sphere. The second portion defining cavity 9761, illustrated as cavity bottom 976K, preferably is a lens plate with aspherical lenses 9761 on one side and interference filters 977 preferably deposited on the opposite side. The regions between the lenses preferably are mirrored to cause optical reflection back into the cavity. The bottom portion of the manifold preferably is bonded to the top portion with a suitable adhesive. Jung at 89:39-53. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d]. the wearable measurement device further comprising a receiver configured to:	Jung disclose or renders obvious the wearable measurement device further comprising a receiver.

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	 R - LIGHT RECEIVER FIBER OPTICS S - LIGHT SOURCE FIBER OPTIC FIG. 2 Jung at Fig.2. Light reflected from the object is detected by a number of light receivers. Included in the light receivers (which may be light receiver fiber optics) are a plurality of perimeter and/or broadband or other receivers (which may be light receiver fiber optics, etc.). Jung at 4:13-17. Probe tip 1 encloses a plurality of fiber optics, each of which may constitute one or more fiber optic fibers. In a preferred embodiment, the fiber optics contained within probe tip 1 includes a single light source fiber optic and a number of groups of light receiver fiber optics. The use of such fiber optics to measure the color or other optical characteristics of an object will be described later herein. Probe tip 1 is attached to probe body 2, on which is fixed switch 17. Switch 17 communicates with microprocessor 10 through wire 18 and provides, for example, a mechanism by which an operator may activate the device in order to make a color/optical measurement. Fiber optics within probe tip 1 terminate at the forward end thereof (i.e., the end away from probe body 2). The forward end of probe tip 1 is directed towards the surface of the object to be measured as described more fully below. The fiber optics within probe tip 1 optically extend through probe body 2 and through fiber optic cable 3 to light sensors 8, which are coupled to microprocessor 10.

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	Jung at 8:47-65. With reference to FIG. 2, an embodiment of a fiber optic arrangement presented at the forward end of probe tip 1 will now be described, which may serve to further the understanding of preferred embodiments of the present invention. As illustrated in FIG. 2, this embodiment utilizes a single central light source fiber optic, denoted as light source fiber optics, and a plurality of perimeter light receiver fiber optics, denoted as light receivers R1, R2 and R3. As is illustrated, this embodiment utilizes three perimeter fiber optics, although in other embodiments two, four or some other number of receiver fiber optics are utilized. As more fully described herein, the perimeter light receiver fiber optics serve not only to provide reflected light for purposes of making the color/optical measurement, but such perimeter fibers also serve to provide information regarding the angle and height of probe tip 1 with respect to the surface of the object that is being measured, and also may provide information regarding the surface characteristics of the object that is being measured. Jung at 11:22-40. In the illustrated embodiment, receiver fiber optics R1 to R3 are positioned symmetrically around source fiber optic S, with a spacing of about 120 degrees from each other. It should be noted that spacing t is provided between receiver fiber optics R1 to R3 and source fiber optic S. While the precise angular placement of the receiver fiber optics around the perimeter of the fiber bundle in general is not critical, it has been determined that three receiver fiber optics positioned 120 degrees apart generally may give acceptable results. As discussed above, in certain embodiments light receiver fiber optics R1 to R3 each constitute a single fiber, which is divided at splicing connector 4 (refer again to FIG. 1), or, in alternate embodiments, light receiver fiber optics R1 to R3 each constitute a bundle of fibers, numbering, for example, at least five fibers per bundle. It has been determined that, with available fibers of uniform size, a bundle of, for example, seven fibers may be readily produced (although as will be apparent to one of skill in the art, the precise number of fibers may be determined in view of the desired number of receiver fiber optics, manufacturing considerations, etc.). The use of light receiver fiber optics R1 to R3 to produce color/optical measurements is further described elsewhere herein, although it may be noted here that receiver fiber optics R1 to R3 may serve to detect whether, for example, the angle of probe tip 1 with respect to the surface of the object being measured is at 90 degrees, or if the surface of the object being measured contains surface texture and/or spectral irregularities. In the case where probe tip 1 is perpendicular to the surface of the object being measured and the surface of the object being measured

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	is a diffuse reflector (i.e., a matte-type reflector, as compared to a glossy or spectral or shiny-type reflector which may have “hot spots”), then the light intensity input into the perimeter fibers should be approximately equal. It also should be noted that spacing t serves to adjust the optimal height at which color/optical measurements should be made (as more fully described below). Preferred embodiments, as described hereinafter, may enable the quantification of the gloss or degree of spectral reflection of the object being measured. Jung at 11:41-12:13. Light conduit 340 in this embodiment serves to conduct light from the light source to the surface of the object being measured, and also to receive reflected light from the surface and conduct it to light receiver fiber optics 346 in probe handle 344. Light conduit 340 is held in position with respect to fiber optics 346 by way or compression jaws 342 or other suitable fitting or coupled that reliably positions light conduit 340 so as to couple light effectively to/from fiber optics 346. Fiber optics 346 may be separated into separate fibers/light conduits 348, which may be coupled to appropriate light sensors, etc., as with previously described embodiments. Jung at 22:65-23:9. FIG. 10A illustrates another such embodiment, similar to the embodiment discussed with reference to FIG. 9. Probe tip 100 includes central source fiber optic 106, surrounded by (and spaced apart from) three perimeter receiver fiber optics 104 and a plurality of color receiver fiber optics 102. The number of color receiver fiber optics 102, and the filters associated with such receiver fiber optics 102, may be chosen based upon the particular application. As with the embodiment of FIG. 9, the process described with reference to FIG. 6 generally is applicable to this embodiment. Jung at 24:39-48. FIG. 10B illustrates another such embodiment in which there are a plurality of receiver fiber optics that surround central source fiber optic 240. The receiver fiber optics are arranged in rings surrounding the central source fiber optic. FIG. 10B illustrates three rings of receiver fiber optics (consisting of fiber optics 242, 244 and 246, respectively), in which there are six receiver fiber optics per ring. The rings may be arranged in successive larger circles as illustrated to cover the entire area of the end of the probe, with the distance from each receiver fiber optic within a given ring to the central fiber optic being equal

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	(or approximately so). Central fiber optic 240 is utilized as the light source fiber optic and is connected to the light source in a manner similar to light source fiber optic 5 illustrated in FIG. 1. Jung at 24:49-62. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample	Jung discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. Light reflected from the object is detected by a number of light receivers. Included in the light receivers (which may be light receiver fiber optics) are a plurality of perimeter and/or broadband or other receivers (which may be light receiver fiber optics, etc.). Jung at 4:13-17. Probe tip 1 encloses a plurality of fiber optics, each of which may constitute one or more fiber optic fibers. In a preferred embodiment, the fiber optics contained within probe tip 1 includes a single light source fiber optic and a number of groups of light receiver fiber optics. The use of such fiber optics to measure the color or other optical characteristics of an object will be described later herein. Probe tip 1 is attached to probe body 2, on which is fixed switch 17. Switch 17 communicates with microprocessor 10 through wire 18 and provides, for example, a mechanism by which an operator may activate the device in order to make a color/optical measurement. Fiber optics within probe tip 1 terminate at the forward end thereof (i.e., the end away from probe body 2). The forward end of probe tip 1 is directed towards the surface of the object to be measured as described more fully below. The fiber optics within probe tip 1 optically extend through probe body 2 and through fiber optic cable 3 to light sensors 8, which are coupled to microprocessor 10. Jung at 8:47-65.

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	In general, under control of microprocessor 10, which may be in response to operator activation (through, for example, key pad switches 12 or switch 17), light is directed from light source 11, and reflected from cold mirror 6 through source fiber optic 5 (and through fiber optic cable 3, probe body 2 and probe tip 1) or through some other suitable light source element and is directed onto object 20. Light reflected from object 20 passes through the receiver fiber optics/elements in probe tip 1 to light sensors 8 (through probe body 2, fiber optic cable 3 and fibers 7). Based on the information produced by light sensors 8, microprocessor 10 produces a color/optical measurement result or other information to the operator. Color measurement or other data produced by microprocessor 10 may be displayed on display 14, passed through UART 13 to computer 13A, or used to generate audio information that is presented to speaker 16. Other operational aspects of the preferred embodiment illustrated in FIG. 1 will be explained hereinafter. Jung at 11:4-21. With reference to FIG. 3, a partial arrangement of light receiver fiber optics and sensors that may be used in a preferred embodiment of the present invention will now be described. Fibers 7 represent light receiving fiber optics, which transmit light reflected from the object being measured to light sensors 8. In an exemplary embodiment, sixteen sensors (two sets of eight) are utilized, although for ease of discussion only 8 are illustrated in FIG. 3 (in this preferred embodiment, the circuitry of FIG. 3 is duplicated, for example, in order to result in sixteen sensors). In other embodiments, other numbers of sensors are utilized in accordance with the present invention. Jung at 12:22-33. The outputs of sensing elements 24 are, in this embodiment, asynchronous signals of frequencies depending upon the light intensity presented to the particular sensing elements, which are presented to processor 26. In a preferred embodiment, processor 26 is a Microchip PIC16C55 or PIC16C57 microprocessor, which as described more fully herein implements an algorithm to measure the frequencies of the signals output by sensing elements 24. In other embodiments, a more integrated microprocessor/micro controller, such as Hitachi's SH RISC microcontrollers, is utilized to provide further system integration or the like.

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	As previously described, processor 26 measures the frequencies of the signals output from sensing elements 24. In a preferred embodiment, processor 26 implements a software timing loop, and at periodic intervals processor 26 reads the states of the outputs of sensing elements 24. An internal counter is incremented each pass through the software timing loop. The accuracy of the timing loop generally is determined by the crystal oscillator time base (not shown in FIG. 3) coupled to processor 26 (such oscillators typically are quite stable). After reading the outputs of sensing elements 24, processor 26 performs an exclusive OR ("XOR") operation with the last data read (in a preferred embodiment such data is read in byte length). If any bit has changed, the XOR operation will produce a 1, and, if no bits have changed, the XOR operation will produce a 0. If the result is non-zero, the input byte is saved along with the value of the internal counter (that is incremented each pass through the software timing loop). If the result is zero, the systems waits (e.g., executes no operation instructions) the same amount of time as if the data had to be saved, and the looping operation continues. The process continues until all eight inputs have changed at least twice, which enables measurement of a full ½ period of each input. Upon conclusion of the looping process, processor 26 analyzes the stored input bytes and internal counter states. There should be 2 to 16 saved inputs (for the 8 total sensors of FIG. 3) and counter states (if two or more inputs change at the same time, they are saved simultaneously). As will be understood by one of skill in the art, the stored values of the internal counter contains information determinative of the period of the signals received from sensing elements 24. By proper subtraction of internal counter values at times when an input bit has changed, the period may be calculated. Such periods calculated for each of the outputs of sensing elements is provided by processor 26 to microprocessor 10 (see, e.g., FIG. 1). From such calculated periods, a measure of the received light intensities may be calculated. In alternate embodiments, the frequency of the outputs of the TSL230 sensors is measured directly by a similar software loop as the one described above. The outputs are monitored by the RISC processor in a software timing loop and are XORed with the previous input as described above. If a transition occurs for a particular TSL230 input, a counter register for the particular TSL230 input is incremented. The software loop is executed for a pre-determined period of time and the frequency of the input is calculated by dividing the number of transitions by the pre-determined time and scaling the result. It will also be apparent to one skilled in the art that more sophisticated measurement schemes can also be implemented whereby both the frequency and period are simultaneously measured by high speed RISC processors such as those of the Hitachi SH family. Jung at 12:62-13:46

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	In yet another illustrative example, an assessment or prediction of the characteristics of an underlying material, such as the pulpal tissue within a tooth may be made. Such capabilities may be further enhanced by comparisons with measurements taken of the object at an earlier time, such as data taken of the tooth or other object at one or more earlier points in time. Such comparisons based on such historical data and/or stored data may allow highly useful assessments or predictions of the current or projected condition or status of the tooth, tissue or other object, etc. Many other industrial uses of such surface and subsurface assessment/prediction capabilities are possible. Jung at 14:56-67. Light conduit 340 in this embodiment serves to conduct light from the light source to the surface of the object being measured, and also to receive reflected light from the surface and conduct it to light receiver fiber optics 346 in probe handle 344. Light conduit 340 is held in position with respect to fiber optics 346 by way or compression jaws 342 or other suitable fitting or coupled that reliably positions light conduit 340 so as to couple light effectively to/from fiber optics 346. Fiber optics 346 may be separated into separate fibers/light conduits 348, which may be coupled to appropriate light sensors, etc., as with previously described embodiments. Jung at 22:65-23:9. With this embodiment, the light is received and output from receiver fiber optics 7, and the light received by linear optical sensor 112 is integrated for a short period of time (determined by the light intensity, filter characteristics and desired accuracy). The output of linear array sensor 112 is digitized by ADC 114 and output to microprocessor 116 (which may the same processor as microprocessor 10 or another processor). Jung at 25:53-61. The output of matrix optical sensor 122 is digitized by ADC 124 and output to microprocessor 126 (which may the same processor as microprocessor 10 or another processor). Under control of microprocessor 126, matrix optical sensor 126 collects data from receiver fiber optics 7 through color filter grid 120. Jung at 26:12-17.

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	Optical measurements may be made with such a probe by holding/positioning the probe near the surface of the object being measured (i.e., within the range of acceptable heights of the particular probe). The light source providing light to light source 310 is turned on and the reflected light received by receivers 312-320 (coupled to the perimeter sensors) is measured. The light intensity of the rings of triad sensors is compared. Generally, if the probe is perpendicular to the surface and if the surface is flat, the light intensity of the three sensors of each triad should be approximately will be equal. If the probe is not perpendicular to the surface or if the surface is not flat, the light intensity of the three sensors within a triad will not be equal. It is thus possible to determine if the probe is perpendicular to the surface being measured, etc. It also is possible to compensate for non-perpendicular surfaces by mathematically adjusting the light intensity measurements of the color sensors with the variance in measurements of the triads of perimeters sensors. Jung at 33:61-34:11. One or more of receiver(s) B 454 (in certain embodiments one receiver B may be utilized, while in other embodiments a plurality of receivers B are utilized, which may be circularly arranged around source A, such as 6 or 8 such receivers B) pass to a spectrometer (see, e.g., FIGS. 1, 3, 11, 12, configured as appropriate for such preferred embodiments). Receiver(s) B 454 are used to measure the spectrum of the reflected light. Receivers C 456 and D 458 pass to broad band (wavelength) optical receivers and are used to correct the measurement made by receiver(s) B. Receivers C 456 and D 458 are used to correct for and to detect whether or not the probe is perpendicular to the surface and to measure/assess the degree of specular versus diffuse reflection (the coefficient of specular reflection, etc.) and to measure the translucency of the material/object. Jung at 39:51-65. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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11[f]. generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Jung discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. The data output from light sensors 8 pass to microprocessor 10. Microprocessor 10 processes the data from light sensors 8 to produce a measurement of color and/or other characteristics. Microprocessor 10 also is coupled to key pad switches 12, which serve as an input device. Through key pad switches 12, the operator may input control information or commands, or information relating to the object being measured or the like. In general, key pad switches 12, or other suitable data input devices (such as push button, toggle, membrane or other switches or the like), serve as a mechanism to input desired information to microprocessor 10. Jung at 10:6-17. In general, under control of microprocessor 10, which may be in response to operator activation (through, for example, key pad switches 12 or switch 17), light is directed from light source 11, and reflected from cold mirror 6 through source fiber optic 5 (and through fiber optic cable 3, probe body 2 and probe tip 1) or through some other suitable light source element and is directed onto object 20. Light reflected from object 20 passes through the receiver fiber optics/elements in probe tip 1 to light sensors 8 (through probe body 2, fiber optic cable 3 and fibers 7). Based on the information produced by light sensors 8, microprocessor 10 produces a color/optical measurement result or other information to the operator. Color measurement or other data produced by microprocessor 10 may be displayed on display 14, passed through UART 13 to computer 13A, or used to generate audio information that is presented to speaker 16. Other operational aspects of the preferred embodiment illustrated in FIG. 1 will be explained hereinafter. Jung at 11:4-21. In yet another illustrative example, an assessment or prediction of the characteristics of an underlying material, such as the pulpal tissue within a tooth may be made. Such capabilities may be further enhanced by comparisons with measurements taken of the object at an earlier time, such as data taken of the tooth or other object at one or more earlier points in time. Such comparisons based on such historical data and/or stored data may allow highly useful assessments or predictions of the current or projected

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	condition or status of the tooth, tissue or other object, etc. Many other industrial uses of such surface and subsurface assessment/prediction capabilities are possible. Jung at 14:56-67. With teeth postureized as illustrated in FIG. 25, computer 384 may then highlight (such as with a colored border, shading, highlight or the like) a particular color region on a tooth to be measured, and then the dentist may then measure the highlighted region with intraoral reflectometer 380. The output of intraoral reflectometer 380 is input to computer 384 over bus 390, and computer 384 may store in memory or on a hard disk or other storage medium the color/optical data associated with the highlighted region. Computer 384 may then highlight another region and continue the process until color/optical data associated with all desired highlighted regions have been stored in computer 384. Such color/optical data may then be stored in a suitable data base, along with the video image and postureized video image of the particular teeth, etc. Jung at 37:4-18. One or more of receiver(s) B 454 (in certain embodiments one receiver B may be utilized, while in other embodiments a plurality of receivers B are utilized, which may be circularly arranged around source A, such as 6 or 8 such receivers B) pass to a spectrometer (see, e.g., FIGS. 1, 3, 11, 12, configured as appropriate for such preferred embodiments). Receiver(s) B 454 are used to measure the spectrum of the reflected light. Receivers C 456 and D 458 pass to broad band (wavelength) optical receivers and are used to correct the measurement made by receiver(s) B. Receivers C 456 and D 458 are used to correct for and to detect whether or not the probe is perpendicular to the surface and to measure/assess the degree of specular versus diffuse reflection (the coefficient of specular reflection, etc.) and to measure the translucency of the material/object. Jung at 39:51-65. Accordingly, in accordance with the present invention, the color or other optical characteristics of a sub-surface structure, such as DEJ 542 of a tooth, may be assessed or quantified in a manner that is in general independent of the optical characteristics of the surface of the tooth, and do so non-invasively, and do so in a manner that may also assess the thickness of the outer layer, such as enamel layer 540.

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	Jung at 45:63-46:2. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	Jung discloses or renders obvious the receiver configured to synchronize to the light source. Optical measurements may be made with such a probe by holding/positioning the probe near the surface of the object being measured (i.e., within the range of acceptable heights of the particular probe). The light source providing light to light source 310 is turned on and the reflected light received by receivers 312-320 (coupled to the perimeter sensors) is measured. The light intensity of the rings of triad sensors is compared. Generally, if the probe is perpendicular to the surface and if the surface is flat, the light intensity of the three sensors of each triad should be approximately will be equal. If the probe is not perpendicular to the surface or if the surface is not flat, the light intensity of the three sensors within a triad will not be equal. It is thus possible to determine if the probe is perpendicular to the surface being measured, etc. It also is possible to compensate for non-perpendicular surfaces by mathematically adjusting the light intensity measurements of the color sensors with the variance in measurements of the triads of perimeters sensors. Jung at 33:61-34:11. In one alternate embodiment, the three monochrome sources are not filtered and are supplied light with the same spectral properties as the inner and outer rings (the three sources in such embodiments may not be monochrome, but may be broad-band). With such an alternate embodiment, the light sources may be alternately turned on and off in a manner synchronous with the measurement of spectral data. As an exemplary operation of such an alternative, as the probe approaches a material or object, the inner ring source may be turned on and a measurement is made. The inner ring may then be turned off and the outer ring turned on and a measurement is made. Both inner and outer rings may then be turned off and the

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	three monochrome (or broadband) sources are each in turn turned on and off as a measurement is made. The plurality of spectrums or measurements are utilized to determine the optical properties of the material and to measure and/or adjust for height and angular changes in accordance with previously described principles. Jung at 67:48-65. Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise. Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The three monochrome sources, however, are turned on and off rapidly, synchronous with the spectral measurements being taken at, for example, a rate of 1000 Hz. The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations. Jung at 68:13-32. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the	Jung discloses or renders obvious the receiver configure to capture light while the semiconductor sources are off and convert the captured light into a first signal.

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captured light into a first signal,	FIG. 38 illustrates an abridged visible light range spectrometer in accordance with another embodiment of the present invention. This embodiment utilizes TSL230 sensors 616, a light source or lamp 604, preferably a hot mirror that reflects IR light with wavelengths above 700 nanometers (not expressly shown in FIG. 38), fiber optic cable assembly consisting of one or more sources (illustrated by light path 608) providing light to object 606, and one or more receivers (illustrated by light path 618) receiving light from object 606, gate array 602 such as an Altera FLEX 10K30™ (believed to be a trademark of Altera Corporation), which is coupled to computer 600 and receives signal inputs from sensors 616 over bus 620. In one preferred embodiment up to fifteen or more TSL230 sensors are utilized. Each TSL230 sensor 616 has an interference filter 614 positioned above the sensor, with each filter preferably having a nominal bandwidth of 20 nanometers (or other bandwidth suitable for the particular application). Sensors 616 also preferably receive a small and controlled amount of light (light path 610) directly from light source 604, preferably after IR filtering. The light source input to sensors 616 serves to bias sensors 616 to produce an output of at least 200 Hz when no light is input to sensors 616 from filters 614. Thus, sensors 616 will always produce an output signal frequency greater than or equal to the sampling frequency of the system. When input light intensities are small, the frequency change is small, and when the light input is large, the frequency change will be large. The scale and sensitivity of sensors 616 are set (by gate array 602 over control bus 612, which may be under control of computer 600) to detect the entire range of light input values. In most cases, particularly in object color determination, the maximum amount of light input into any one of sensors 616 is determined by light source 604 and filters 614 and can be appropriately controlled. Jung at 50:13-45. In one alternate embodiment, the three monochrome sources are not filtered and are supplied light with the same spectral properties as the inner and outer rings (the three sources in such embodiments may not be monochrome, but may be broad-band). With such an alternate embodiment, the light sources may be alternately turned on and off in a manner synchronous with the measurement of spectral data. As an exemplary operation of such an alternative, as the probe approaches a material or object, the inner ring source may be turned on and a measurement is made. The inner ring may then be turned off and the outer ring turned on and a measurement is made. Both inner and outer rings may then be turned off and the three monochrome (or broadband) sources are each in turn turned on and off as a measurement is made. The plurality of spectrums or measurements are utilized to determine the optical properties of the material and to measure and/or adjust for height and angular changes in accordance with previously described principles.

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	Jung at 67:48-65. Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise. Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The three monochrome sources, however, are turned on and off rapidly, synchronous with the spectral measurements being taken at, for example, a rate of 1000 Hz. The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations. Jung at 68:13-32. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis	Jung discloses or renders obvious the receiver configure to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. In yet another illustrative example, an assessment or prediction of the characteristics of an underlying material, such as the pulpal tissue within a tooth may be made. Such capabilities may be further enhanced by comparisons with measurements taken of the object at an earlier time, such as data taken of the tooth

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output beam reflected or transmitted from the sample,	or other object at one or more earlier points in time. Such comparisons based on such historical data and/or stored data may allow highly useful assessments or predictions of the current or projected condition or status of the tooth, tissue or other object, etc. Many other industrial uses of such surface and subsurface assessment/prediction capabilities are possible. Jung at 14:56-67. Optical measurements may be made with such a probe by holding/positioning the probe near the surface of the object being measured (i.e., within the range of acceptable heights of the particular probe). The light source providing light to light source 310 is turned on and the reflected light received by receivers 312-320 (coupled to the perimeter sensors) is measured. The light intensity of the rings of triad sensors is compared. Generally, if the probe is perpendicular to the surface and if the surface is flat, the light intensity of the three sensors of each triad should be approximately will be equal. If the probe is not perpendicular to the surface or if the surface is not flat, the light intensity of the three sensors within a triad will not be equal. It is thus possible to determine if the probe is perpendicular to the surface being measured, etc. It also is possible to compensate for non-perpendicular surfaces by mathematically adjusting the light intensity measurements of the color sensors with the variance in measurements of the triads of perimeters sensors. Jung at 33:61-34:11. In one alternate embodiment, the three monochrome sources are not filtered and are supplied light with the same spectral properties as the inner and outer rings (the three sources in such embodiments may not be monochrome, but may be broad-band). With such an alternate embodiment, the light sources may be alternately turned on and off in a manner synchronous with the measurement of spectral data. As an exemplary operation of such an alternative, as the probe approaches a material or object, the inner ring source may be turned on and a measurement is made. The inner ring may then be turned off and the outer ring turned on and a measurement is made. Both inner and outer rings may then be turned off and the three monochrome (or broadband) sources are each in turn turned on and off as a measurement is made. The plurality of spectrums or measurements are utilized to determine the optical properties of the material and to measure and/or adjust for height and angular changes in accordance with previously described principles. Jung at 67:48-65.

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	Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise. Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The three monochrome sources, however, are turned on and off rapidly, synchronous with the spectral measurements being taken at, for example, a rate of 1000 Hz. The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations. Jung at 68:13-32. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Jung discloses or renders obvious capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. FIGS. 8A and 8B illustrate another embodiment of a removable probe tip that may be used to reduce contamination in accordance with the present invention. As illustrated in FIG. 8A, probe tip 88 is removable, and includes four (or a different number, depending upon the application) fiber optic connectors 90, which are positioned within optical guard 92 coupled to connector 94. Optical guard 92 serves to prevent “cross talk” between adjacent fiber optics. As illustrated in FIG. 8B, in this embodiment removable tip 88 is secured in probe tip housing 93 by way of spring clip 96 (other removable retaining

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	implements are utilized in other embodiments). Probe tip housing 93 may be secured to base connector 95 by a screw or other conventional fitting. It should be noted that, with this embodiment, different size tips may be provided for different applications, and that an initial step of the process may be to install the properly-sized (or fitted tip) for the particular application. Removable tip 88 also may be sterilized in a typical autoclave, hot steam, chemiclave or other sterilizing system, or disposed of. In addition, the entire probe tip assembly is constructed so that it may be readily disassembled for cleaning or repair. In certain embodiments the light source/receiver elements of the removable tip are constructed of glass, silica or similar materials, thereby making them particularly suitable for autoclave or similar high temperature/pressure cleaning methods, which in certain other embodiments the light source/receiver elements of the removable tip are constructed of plastic or other similar materials, which may be of lower cost, thereby making them particularly suitable for disposable-type removable tips, etc. Jung at 22:12-42. In general, the aperture of the fiber optics used in light conduit 340 may be chosen to match the aperture of the fiber optics for the light source and the light receivers or alternately the light conduit aperture could be greater than or equal to the largest source or receiver aperture. Thus, the central part of the light conduit may conduct light from the light source and illuminate the surface as if it constituted a single fiber within a bundle of fibers. Similarly, the outer portion of the light conduit may receive reflected light and conduct it to light receiver fiber optics as if it constituted single fibers. Light conduit 340 has ends that preferably are highly polished and cut perpendicular, particularly the end coupling light to fiber optics 346. Similarly, the end of fiber optics 346 abutting light conduit 340 also is highly polished and cut perpendicular to a high degree of accuracy in order to minimize light reflection and cross talk between the light source fiber optic and the light receiver fiber optics and between adjacent receiver fiber optics. Light conduit 340 offers significant advantages including in the manufacture and installation of such a removable tip. For example, the probe tip need not be particularly aligned with the probe tip holder; rather, it only needs to be held against the probe tip holder such as with a compression mechanism (such as with compression jaws 342) so as to couple light effectively to/from fiber optics 346. Thus, such a removable tip mechanism may be implemented without alignment tabs or the like, thereby facilitating easy installation of the removable probe tip. Such an easy installable probe tip may thus be removed and cleaned prior to installation, thereby facilitating use of the color/optical measuring apparatus by dentists, medical professions or others working in an environment in which contamination may be a concern. Light conduit 340 also may be implemented, for example, as a small section of light conduit, which may facilitate easy and low cost mass production and the like.

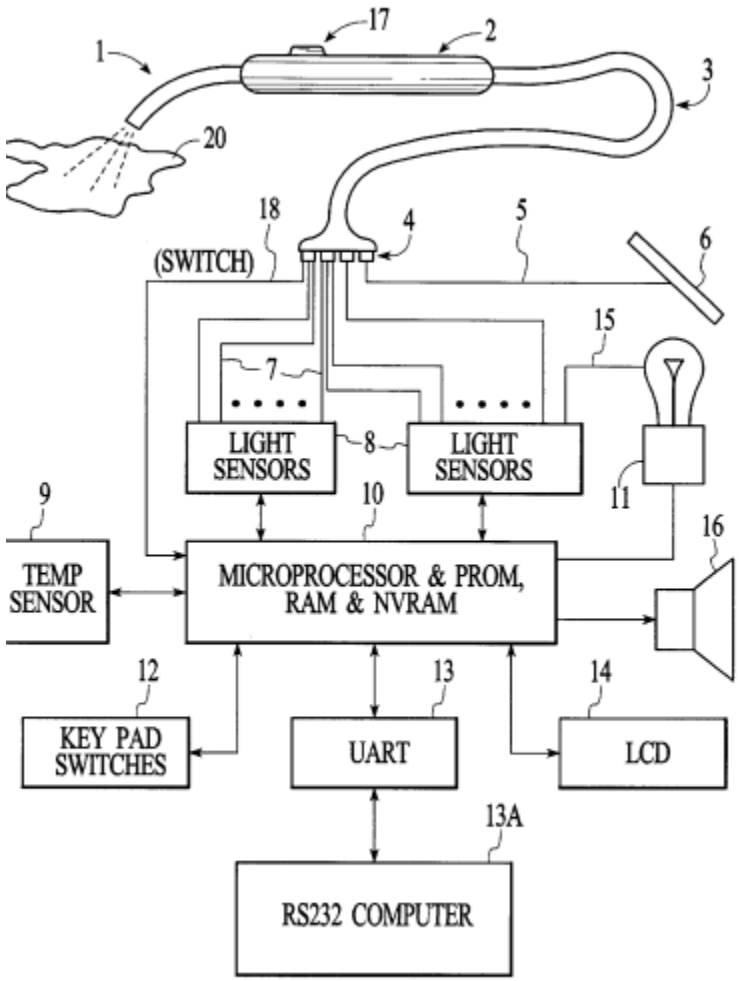
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	Jung at 23:10-44. Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise. Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The three monochrome sources, however, are turned on and off rapidly, synchronous with the spectral measurements being taken at, for example, a rate of 1000 Hz. The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations. Jung at 68:13-32. In accordance with such embodiments, each interference filter is positioned above an electro-optical sensor. In certain preferred embodiments, the sensors are light to frequency converter sensors, such as those manufactured by Texas Advanced Optical Systems (formerly Texas Instruments). Without being bound by theory, such sensing elements will now be further described. The light to frequency converter sensors generally are an array of photo diodes 1.25 mm square. There are 100 or other number of photo diodes in each array. Thus 100 (or other number) photo diodes serve as sensors for each interference filter providing high sensitivity and low electrical noise. Such light to frequency converters have a PWM (pulse width modulation) TTL compatible digital signal output. They produce a PWM signal whose frequency is directly proportional to the intensity of the input light. Since the light incident upon each light to frequency converter is notch filtered by its corresponding interference filter, its output represents the integral intensity of a portion of the optical spectrum. The combined output of all sensors is an abridged optical spectrum. Jung at 93:20-39.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	Jung discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link.

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	 FIG. 1 Jung at Fig.1

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	Microprocessor 10 also communicates with UART 13, which enables microprocessor 10 to be coupled to an external device such as computer 13A. In such embodiments, data provided by microprocessor 10 may be processed as desired for the particular application, such as for averaging, format conversion or for various display or print options, etc. In the preferred embodiment, UART 13 is configured so as to provide what is known as a RS232 interface, such as is commonly found in personal computers. Jung at 10:17-27. In general, under control of microprocessor 10, which may be in response to operator activation (through, for example, key pad switches 12 or switch 17), light is directed from light source 11, and reflected from cold mirror 6 through source fiber optic 5 (and through fiber optic cable 3, probe body 2 and probe tip 1) or through some other suitable light source element and is directed onto object 20. Light reflected from object 20 passes through the receiver fiber optics/elements in probe tip 1 to light sensors 8 (through probe body 2, fiber optic cable 3 and fibers 7). Based on the information produced by light sensors 8, microprocessor 10 produces a color/optical measurement result or other information to the operator. Color measurement or other data produced by microprocessor 10 may be displayed on display 14, passed through UART 13 to computer 13A, or used to generate audio information that is presented to speaker 16. Other operational aspects of the preferred embodiment illustrated in FIG. 1 will be explained hereinafter. Jung at 11:4-21. With the spectral/color information produced by the present invention, data may be converted to such formats through conventional math, for example. Such math may be performed by microprocessor 10 or computer 13A of FIG. 1, or in some other manner. It also should be noted that, in certain embodiments, the data produced at step 204 in accordance with the present invention may be used directly without data conversion. Jung at 29:17-24. In a further refinement to the foregoing embodiment, computer 384 preferably has included therein, or coupled thereto, a modem. With such a modem capability (which may be hardware or software), computer 384 may couple data to remote computer 386 over telecommunication channel 388. For example, remote computer 386 may be located at a dental laboratory remotely located. Video images

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	captured using intraoral camera 382 and color/optical data collected using intraoral reflectometer may be transmitted to a dental technician (for example) at the remote location, who may use such images and data to construct dental prosthesis. Additionally, computer 384 and remote computer 386 may be equipped with an internal or external video teleconference capability, thereby enabling a dentist and a dental technician or ceramist, etc., to have a live video or audio teleconference while viewing such images and/or data. Jung at 37:49-64. The system battery may be charged in charging stand 526 in a conventional manner. A charging indicator (such as lamps 528) may be used to provide an indication of the state of the internal battery. Unit 500 may be removed from the stand, and an optical measurement may be made by the dentist. If the dentist chooses, the optical measurement may be read from display 502, and a prescription may be handwritten or otherwise prepared by the dentist. Alternately, the color/optical characteristics data may be transmitted by wireless IR transceiver 514 (or other cordless system such as RF) to a wireless transceiver, such as transceiver 530 of charging stand 526. The prescription may then be electronically created based upon the color/optical characteristics data. The electronic prescription may be sent from serial port 524 to a computer or modem or other communications channel to the dental laboratory. Jung at 44:50-64. Computer 642 may be a conventional computer such as a PC or microcontroller or other processing device, and preferably is coupled to a user interface (e.g., display, control switches, keyboard, etc.), which is generically illustrated in FIG. 39 by interface 652. Optionally, computer 642 is coupled to other computing devices, such as may be used for data processing, manipulation, storage or further display, through interface 650. Computer 642 preferably includes the typical components such as (but not limited to) a CPU, random access or other memory, non-volatile memory/storage for storing program code, and may include interfaces for the user such as display, audio generators, keyboard or keypad or touch screen or mouse or other user input device (which may be through interface 652), and optionally interfaces to other computers such as parallel or serial interfaces (which may be through interface 650). Computer 642 interfaces to spectrometer/light sensors 640 for control of the spectrometer and overall system and to receive light intensity and light spectrum data from spectrometer/light sensors 640. In a preferred embodiment, control/data bus 648 for interfacing to spectrometer/light sensors 640 is a standard 25 pin bi-directional parallel port. In certain embodiments, computer 642 may be separate, standalone and/or

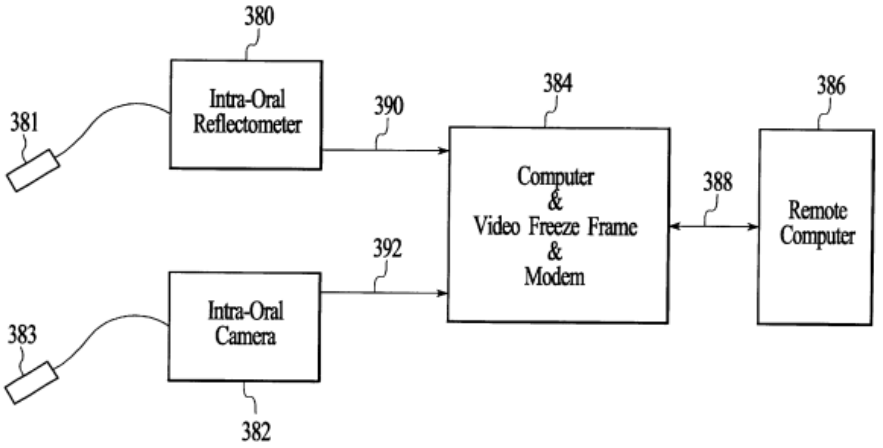
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	detachable from spectrometer/light sensors 640 and may be a conventional laptop, notebook or other portable or handheld-type personal computer. In other embodiments, computer 642 may be an integral part of the system contained in one or more enclosure(s), and may be an embedded personal computer or other type of integrated computer. Purposes of computer 642 preferably include controlling light source 638 and spectrometer/light sensors 640, receiving light intensity and spectral or other data output from spectrometer/light sensors 640, analyzing received or other data and determining the optical properties of the object or material, and displaying or outputting data to a user or other computing device or data gathering system. Jung at 52:17-55. As described elsewhere herein, a spectrometer system may be constructed of Texas Instruments TSL230 light sensors, interference filters, light biasing elements and a gate array such an Altera FLEX 10K30 in order to control the light sensors, interface to a computer via a parallel or other interface and to measure the frequency and period of the light sensors simultaneously at a high rate in order to accurately and rapidly measure light spectrums and light intensities. Although such spectrometer systems are used in preferred embodiments, other spectrometers such as those utilizing, for example, CCDs with diffraction gratings are utilized in other embodiments. Jung at 55:1-12. FIG. 56 illustrates an embodiment of the present invention utilizing such techniques. Such an embodiment preferably includes a spectrometer, light sensors, a CPU or computer, a fiber optic cable and a probe, such as in one or more embodiments described elsewhere herein. Jung at 69:21-25. FIG. 57 illustrates one or more systems 870A, 870B ... 870N having probes 874A, 874B ... 874N, preferably constructed and operated in accordance with previously described embodiments, each of which is adapted to include a modem (illustrated as modems 872A, 872B ... 872N). The modems may be a part of, or coupled to, the CPU, computer or other processing unit included as part of systems 870A, 870B ... 870N (the use of CPUs, computers or other processing units as part of such systems is described elsewhere herein).

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	Jung at 71:30-39. Light detected by sensors 977 generated outputs, which may be processed by processor 981. Input/output may be made to processor 981 by input/output circuitry 982, which may include (such as described elsewhere herein), components of a computer, display, keyboard or switches or other input, etc. Such components optimally may be installed on a small printed circuit board 983 or other appropriate substrate, etc. Jung at 90:17-24. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Jung discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.

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	 FIG. 24 Jung at Fig. 24. At step 210, based on the results of the preceding steps, the prosthesis, denture, intraoral tooth-colored filling material or other items are prepared. This step may be performed at a dental lab, or, in certain embodiments, at or near the dental operatory. For remote preparation, relevant data produced at steps 204, 206 and/or 208 may be sent to the remote lab or facility by hardcopy, facsimile or modem or other transmission. What should be understood from the foregoing is that, based on data collected at step 204, a prosthesis may be prepared of a desirable color and/or other optical characteristic at step 210. Jung at 29:66-30:9. Intraoral reflectometer 380, which may be constructed as described above, includes probe 381. Data output from reflectometer 380 is coupled to computer 384 over bus 390 (which may be a standard serial or parallel bus, etc.). Computer 384 includes a video freeze frame capability and preferably a modem. Intraoral camera 382 includes handpiece 383 and couples video data to computer 384 over bus 392. Computer 384 is coupled to remote computer 386 over telecommunication channel 388, which may be a standard telephone line, ISDN line, a LAN or WAN connection, etc. With such an embodiment, video measurements may be taken of one or more teeth by intraoral camera 382, along with optical

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	measurements taken by intraoral reflectometer 380. Computer 384 may store still picture images taken from the output of intraoral camera 382. Jung at 36:29-43. In a further refinement to the foregoing embodiment, computer 384 preferably has included therein, or coupled thereto, a modem. With such a modem capability (which may be hardware or software), computer 384 may couple data to remote computer 386 over telecommunication channel 388. For example, remote computer 386 may be located at a dental laboratory remotely located. Video images captured using intraoral camera 382 and color/optical data collected using intraoral reflectometer may be transmitted to a dental technician (for example) at the remote location, who may use such images and data to construct dental prosthesis. Additionally, computer 384 and remote computer 386 may be equipped with an internal or external video teleconference capability, thereby enabling a dentist and a dental technician or ceramist, etc., to have a live video or audio teleconference while viewing such images and/or data. Jung at 37:49-64. The system battery may be charged in charging stand 526 in a conventional manner. A charging indicator (such as lamps 528) may be used to provide an indication of the state of the internal battery. Unit 500 may be removed from the stand, and an optical measurement may be made by the dentist. If the dentist chooses, the optical measurement may be read from display 502, and a prescription may be handwritten or otherwise prepared by the dentist. Alternately, the color/optical characteristics data may be transmitted by wireless IR transceiver 514 (or other cordless system such as RF) to a wireless transceiver, such as transceiver 530 of charging stand 526. The prescription may then be electronically created based upon the color/optical characteristics data. The electronic prescription may be sent from serial port 524 to a computer or modem or other communications channel to the dental laboratory. Jung at 44:50-64. In accordance with such embodiments, systems 870A, 870B . . . 870N may be electronically coupled to lab 884, which preferably is remotely located from one or more of the various systems. In one embodiment, lab 884 is able to convey operational commands to one or more of the systems. In one aspect of the present invention, one or more of systems 870A, 870B . . . 870N receive commands

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	initiating a diagnostic or test mode, in response to which the system executes a diagnostic routine that generates diagnostic data (indicative of the operational status, failure mode or other diagnostic type data), which may be coupled to lab 884 by the electronic connection. In other aspects, during normal operation, one or more of the systems periodically capture and store operational data, such as lamp characteristics, calibration or normalization data or the like. The periodic storing of such operational data may be software initiated and/or controlled based on time (e.g., number of lamp or system operating hours), measurements, boot-up or initialization or other triggering event. Upon periodic or other connection to lab 884, such operational data may be transferred to lab 884 for evaluation, analysis, statistical processing and/or storage. In one such embodiment, lab 884 stores a history of such operational data for statistical or diagnostic purposes, such as for initiating a service call for the system, advising or predicting a need for a future service call (such as lamp, filter or other component replacement or repair). As an exemplary application, lab 884 monitors such operational data for key components (such as a light source) over time, and using stored data, look-up table or algorithm predicts remaining life of the component. Thereafter, lab 884 may send data or commands to one or more of systems 870A, 870B . . . 870N in order to have a suitable diagnostic, service call, informational or other message displayed on the system and/or a computer coupled to the system. In still other refinements of such embodiments, lab 884 may also generate an internet or other electronic message to a person or entity providing a status report or other data with respect to the particular system being monitored, diagnosed, controlled, etc. Jung at 72:1-39. Arrow 896 denotes that the motion of probe 890 with respect to standard 892 is a relative motion, and either the probe or the standard may be moved with respect to the other. In certain embodiments, probe 890 is retained in a fixed position, and standard 892 is moved towards probe 890 in a controlled manner, while sensors 894 similarly detect and provide information indicative of the relative position of the probe with respect to the standard. Standard 892 may be controllably moved by a servo motor or the like in order to provide the desired, controlled relative movement between the probe and the standard. If system 888 includes modem 898 or the like, a remote lab or operator may initiate, control, monitor and/or receive data from the calibration or normalization process in a manner similar to that described in connection with FIG. 57. Jung at 73:51-65.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Jung discloses or renders obvious the measurement system is configured to use artificial intelligence in making decisions. With reference to FIG. 1, an exemplary preferred embodiment of a color/optical characteristic measuring system and method in accordance with the present invention will be described. It should be noted that, at various places herein, such a color measuring system is sometimes referred to as an intraoral reflectometer, etc. Jung at 8:41-46. The data output from light sensors 8 pass to microprocessor 10. Microprocessor 10 processes the data from light sensors 8 to produce a measurement of color and/or other characteristics. Microprocessor 10 also is coupled to key pad switches 12, which serve as an input device. Through key pad switches 12, the operator may input control information or commands, or information relating to the object being measured or the like. In general, key pad switches 12, or other suitable data input devices (such as push button, toggle, membrane or other switches or the like), serve as a mechanism to input desired information to microprocessor 10. Jung at 10:6-17. The outputs of sensing elements 24 are, in this embodiment, asynchronous signals of frequencies depending upon the light intensity presented to the particular sensing elements, which are presented to processor 26. In a preferred embodiment, processor 26 is a Microchip PIC16C55 or PIC16C57 microprocessor, which as described more fully herein implements an algorithm to measure the

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	frequencies of the signals output by sensing elements 24. In other embodiments, a more integrated microprocessor/microcontroller, such as Hitachi's SH RISC microcontrollers, is utilized to provide further system integration or the like. Jung at 12:50-61. In yet another illustrative example, an assessment or prediction of the characteristics of an underlying material, such as the pulpal tissue within a tooth may be made. Such capabilities may be further enhanced by comparisons with measurements taken of the object at an earlier time, such as data taken of the tooth or other object at one or more earlier points in time. Such comparisons based on such historical data and/or stored data may allow highly useful assessments or predictions of the current or projected condition or status of the tooth, tissue or other object, etc. Many other industrial uses of such surface and subsurface assessment/prediction capabilities are possible. Jung at 14:56-67. As an exemplary application, lab 884 monitors such operational data for key components (such as a light source) over time, and using stored data, look-up table or algorithm predicts remaining life of the component. Jung at 72:26-30. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a]. wherein the measurement system is configured to perform pattern identification or	Jung discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set.

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classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	With reference to FIG. 1, an exemplary preferred embodiment of a color/optical characteristic measuring system and method in accordance with the present invention will be described. It should be noted that, at various places herein, such a color measuring system is sometimes referred to as an intraoral reflectometer, etc. Jung at 8:41-46. The data output from light sensors 8 pass to microprocessor 10. Microprocessor 10 processes the data from light sensors 8 to produce a measurement of color and/or other characteristics. Microprocessor 10 also is coupled to key pad switches 12, which serve as an input device. Through key pad switches 12, the operator may input control information or commands, or information relating to the object being measured or the like. In general, key pad switches 12, or other suitable data input devices (such as push button, toggle, membrane or other switches or the like), serve as a mechanism to input desired information to microprocessor 10. Jung at 10:6-17. The outputs of sensing elements 24 are, in this embodiment, asynchronous signals of frequencies depending upon the light intensity presented to the particular sensing elements, which are presented to processor 26. In a preferred embodiment, processor 26 is a Microchip PIC16C55 or PIC16C57 microprocessor, which as described more fully herein implements an algorithm to measure the frequencies of the signals output by sensing elements 24. In other embodiments, a more integrated microprocessor/microcontroller, such as Hitachi's SH RISC microcontrollers, is utilized to provide further system integration or the like. Jung at 12:50-61. In yet another illustrative example, an assessment or prediction of the characteristics of an underlying material, such as the pulpal tissue within a tooth may be made. Such capabilities may be further enhanced by comparisons with measurements taken of the object at an earlier time, such as data taken of the tooth or other object at one or more earlier points in time. Such comparisons based on such historical data and/or stored data may allow highly useful assessments or predictions of the current or projected condition or status of the tooth, tissue or other object, etc. Many other industrial uses of such surface and subsurface assessment/prediction capabilities are possible.

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	Jung at 14:56-67. As an exemplary application, lab 884 monitors such operational data for key components (such as a light source) over time, and using stored data, look-up table or algorithm predicts remaining life of the component. Jung at 72:26-30. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Jung discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. FIGS. 8A and 8B illustrate another embodiment of a removable probe tip that may be used to reduce contamination in accordance with the present invention. As illustrated in FIG. 8A, probe tip 88 is removable, and includes four (or a different number, depending upon the application) fiber optic connectors 90, which are positioned within optical guard 92 coupled to connector 94. Optical guard 92 serves to prevent “cross talk” between adjacent fiber optics. As illustrated in FIG. 8B, in this embodiment removable tip 88 is secured in probe tip housing 93 by way of spring clip 96 (other removable retaining implements are utilized in other embodiments). Probe tip housing 93 may be secured to base connector 95 by a screw or other conventional fitting. It should be noted that, with this embodiment, different size tips may be provided for different applications, and that an initial step of the process may be to install the properly-sized (or fitted tip) for the particular application. Removable tip 88 also may be sterilized in a typical autoclave, hot steam, chemiclave or other sterilizing system, or disposed of. In addition, the

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	entire probe tip assembly is constructed so that it may be readily disassembled for cleaning or repair. In certain embodiments the light source/receiver elements of the removable tip are constructed of glass, silica or similar materials, thereby making them particularly suitable for autoclave or similar high temperature/pressure cleaning methods, which in certain other embodiments the light source/receiver elements of the removable tip are constructed of plastic or other similar materials, which may be of lower cost, thereby making them particularly suitable for disposable-type removable tips, etc. Jung at 22:12-42. In yet another illustrative example, an assessment or prediction of the characteristics of an underlying material, such as the pulpal tissue within a tooth may be made. Such capabilities may be further enhanced by comparisons with measurements taken of the object at an earlier time, such as data taken of the tooth or other object at one or more earlier points in time. Such comparisons based on such historical data and/or stored data may allow highly useful assessments or predictions of the current or projected condition or status of the tooth, tissue or other object, etc. Many other industrial uses of such surface and subsurface assessment/prediction capabilities are possible. Jung at 14:56-67. In general, the aperture of the fiber optics used in light conduit 340 may be chosen to match the aperture of the fiber optics for the light source and the light receivers or alternately the light conduit aperture could be greater than or equal to the largest source or receiver aperture. Thus, the central part of the light conduit may conduct light from the light source and illuminate the surface as if it constituted a single fiber within a bundle of fibers. Similarly, the outer portion of the light conduit may receive reflected light and conduct it to light receiver fiber optics as if it constituted single fibers. Light conduit 340 has ends that preferably are highly polished and cut perpendicular, particularly the end coupling light to fiber optics 346. Similarly, the end of fiber optics 346 abutting light conduit 340 also is highly polished and cut perpendicular to a high degree of accuracy in order to minimize light reflection and cross talk between the light source fiber optic and the light receiver fiber optics and between adjacent receiver fiber optics. Light conduit 340 offers significant advantages including in the manufacture and installation of such a removable tip. For example, the probe tip need not be particularly aligned with the probe tip holder; rather, it only needs to be held against the probe tip holder such as with a compression mechanism (such as with compression jaws 342) so as to couple light effectively to/from fiber optics 346. Thus, such a removable tip mechanism may be implemented without alignment tabs or the like, thereby facilitating

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	easy installation of the removable probe tip. Such an easy installable probe tip may thus be removed and cleaned prior to installation, thereby facilitating use of the color/optical measuring apparatus by dentists, medical professions or others working in an environment in which contamination may be a concern. Light conduit 340 also may be implemented, for example, as a small section of light conduit, which may facilitate easy and low cost mass production and the like. Jung at 23:10-44. Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise. Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The three monochrome sources, however, are turned on and off rapidly, synchronous with the spectral measurements being taken at, for example, a rate of 1000 Hz. The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations. Jung at 68:13-32. As an exemplary application, lab 884 monitors such operational data for key components (such as a light source) over time, and using stored data, look-up table or algorithm predicts remaining life of the component. Jung at 72:26-30. In accordance with such embodiments, each interference filter is positioned above an electro-optical sensor. In certain preferred embodiments, the sensors are light to frequency converter sensors, such as those manufactured by Texas Advanced Optical Systems (formerly Texas Instruments). Without being bound by theory, such sensing elements will now be further described. The light to frequency converter sensors generally are an array of photo diodes 1.25 mm square. There are 100 or other number of photo

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	diodes in each array. Thus 100 (or other number) photo diodes serve as sensors for each interference filter providing high sensitivity and low electrical noise. Such light to frequency converters have a PWM (pulse width modulation) TTL compatible digital signal output. They produce a PWM signal whose frequency is directly proportional to the intensity of the input light. Since the light incident upon each light to frequency converter is notch filtered by its corresponding interference filter, its output represents the integral intensity of a portion of the optical spectrum. The combined output of all sensors is an abridged optical spectrum. Jung at 93:20-39. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Jung disclose or renders obvious wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. FIGS. 8A and 8B illustrate another embodiment of a removable probe tip that may be used to reduce contamination in accordance with the present invention. As illustrated in FIG. 8A, probe tip 88 is removable, and includes four (or a different number, depending upon the application) fiber optic connectors 90, which are positioned within optical guard 92 coupled to connector 94. Optical guard 92 serves to prevent “cross talk” between adjacent fiber optics. As illustrated in FIG. 8B, in this embodiment removable tip 88 is secured in probe tip housing 93 by way of spring clip 96 (other removable retaining implements are utilized in other embodiments). Probe tip housing 93 may be secured to base connector 95 by a screw or other conventional fitting. It should be noted that, with this embodiment, different size tips may be provided for different applications, and that an initial step of the process may be to install

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	the properly-sized (or fitted tip) for the particular application. Removable tip 88 also may be sterilized in a typical autoclave, hot steam, chemiclave or other sterilizing system, or disposed of. In addition, the entire probe tip assembly is constructed so that it may be readily disassembled for cleaning or repair. In certain embodiments the light source/receiver elements of the removable tip are constructed of glass, silica or similar materials, thereby making them particularly suitable for autoclave or similar high temperature/pressure cleaning methods, which in certain other embodiments the light source/receiver elements of the removable tip are constructed of plastic or other similar materials, which may be of lower cost, thereby making them particularly suitable for disposable-type removable tips, etc. Jung at 22:12-42. In general, the aperture of the fiber optics used in light conduit 340 may be chosen to match the aperture of the fiber optics for the light source and the light receivers or alternately the light conduit aperture could be greater than or equal to the largest source or receiver aperture. Thus, the central part of the light conduit may conduct light from the light source and illuminate the surface as if it constituted a single fiber within a bundle of fibers. Similarly, the outer portion of the light conduit may receive reflected light and conduct it to light receiver fiber optics as if it constituted single fibers. Light conduit 340 has ends that preferably are highly polished and cut perpendicular, particularly the end coupling light to fiber optics 346. Similarly, the end of fiber optics 346 abutting light conduit 340 also is highly polished and cut perpendicular to a high degree of accuracy in order to minimize light reflection and cross talk between the light source fiber optic and the light receiver fiber optics and between adjacent receiver fiber optics. Light conduit 340 offers significant advantages including in the manufacture and installation of such a removable tip. For example, the probe tip need not be particularly aligned with the probe tip holder; rather, it only needs to be held against the probe tip holder such as with a compression mechanism (such as with compression jaws 342) so as to couple light effectively to/from fiber optics 346. Thus, such a removable tip mechanism may be implemented without alignment tabs or the like, thereby facilitating easy installation of the removable probe tip. Such an easy installable probe tip may thus be removed and cleaned prior to installation, thereby facilitating use of the color/optical measuring apparatus by dentists, medical professions or others working in an environment in which contamination may be a concern. Light conduit 340 also may be implemented, for example, as a small section of light conduit, which may facilitate easy and low cost mass production and the like. Jung at 23:10-44.

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	In certain situations, a long time may be required for the light source and for the light bias source to stabilize. In other situations, the light source and bias source may drift. In preferred embodiments, the light source is a 18 W, 3300 K halogen stabilized tungsten filament lamp manufactured by Welch Allyn, Inc. The light bias preferably is provided by a high intensity LED and a fiber optic light guide or conduit (see LED 680 and light conduit 678 of FIG. 41A) that passes to each biased sensor of sensors 676. The intensity of LED 680 preferably is controlled and varied with high frequency pulse width modulation, or by analog constant currentcontrollers. By controlling the intensity of bias LED 680, the bias light level can be varied to best match the sensor sampling rate. Jung at 56:33-46. Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise. Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The three monochrome sources, however, are turned on and off rapidly, synchronous with the spectral measurements being taken at, for example, a rate of 1000 Hz. The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations. Jung at 68:13-32. In accordance with such embodiments, each interference filter is positioned above an electro-optical sensor. In certain preferred embodiments, the sensors are light to frequency converter sensors, such as those manufactured by Texas Advanced Optical Systems (formerly Texas Instruments). Without being bound by theory, such sensing elements will now be further described. The light to frequency converter sensors generally are an array of photo diodes 1.25 mm square. There are 100 or other number of photo diodes in each array. Thus 100 (or other number) photo diodes serve as sensors for each interference filter providing high sensitivity and low electrical noise. Such light to frequency converters have a PWM (pulse width modulation) TTL compatible digital signal output. They produce a PWM signal whose

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	frequency is directly proportional to the intensity of the input light. Since the light incident upon each light to frequency converter is notch filtered by its corresponding interference filter, its output represents the integral intensity of a portion of the optical spectrum. The combined output of all sensors is an abridged optical spectrum. Jung at 93:20-39. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Jung discloses or renders obvious wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above. In general, under control of microprocessor 10, which may be in response to operator activation (through, for example, key pad switches 12 or switch 17), light is directed from light source 11, and reflected from cold mirror 6 through source fiber optic 5 (and through fiber optic cable 3, probe body 2 and probe tip 1) or through some other suitable light source element and is directed onto object 20. Light reflected from object 20 passes through the receiver fiber optics/elements in probe tip 1 to light sensors 8 (through probe body 2, fiber optic cable 3 and fibers 7). Based on the information produced by light sensors 8, microprocessor 10 produces a color/optical measurement result or other information to the operator. Color measurement or other data produced by microprocessor 10 may be displayed on display 14, passed through UART 13 to computer 13A, or used to generate audio information that is presented to speaker 16. Other operational aspects of the preferred embodiment illustrated in FIG. 1 will be explained hereinafter.

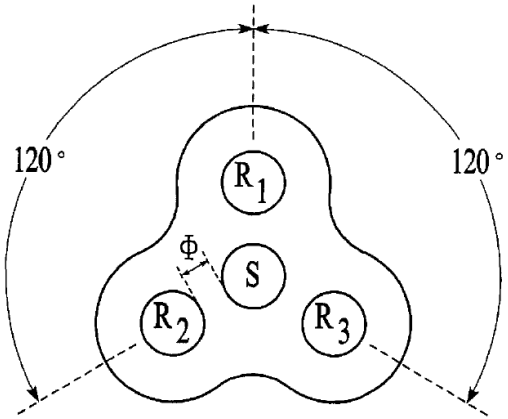
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	Jung at 11:4-21. With reference to FIG. 3, a partial arrangement of light receiver fiber optics and sensors that may be used in a preferred embodiment of the present invention will now be described. Fibers 7 represent light receiving fiber optics, which transmit light reflected from the object being measured to light sensors 8. In an exemplary embodiment, sixteen sensors (two sets of eight) are utilized, although for ease of discussion only 8 are illustrated in FIG. 3 (in this preferred embodiment, the circuitry of FIG. 3 is duplicated, for example, in order to result in sixteen sensors). In other embodiments, other numbers of sensors are utilized in accordance with the present invention. Jung at 12:22-33. In yet another illustrative example, an assessment or prediction of the characteristics of an underlying material, such as the pulpal tissue within a tooth may be made. Such capabilities may be further enhanced by comparisons with measurements taken of the object at an earlier time, such as data taken of the tooth or other object at one or more earlier points in time. Such comparisons based on such historical data and/or stored data may allow highly useful assessments or predictions of the current or projected condition or status of the tooth, tissue or other object, etc. Many other industrial uses of such surface and subsurface assessment/prediction capabilities are possible. Jung at 14:56-67. It is known that certain objects such as human teeth may fluoresce, and such optical characteristics also may be measured in accordance with the present invention. A light source with an ultraviolet component may be used to produce more accurate color/optical data with respect to such objects. Such data may be utilized to adjust the amounts and or proportions or types of dental fluorescing materials in dental restorations or prosthesis. In certain embodiments, a tungsten/halogen source (such as used in a preferred embodiment) may be combined with a UV light source (such as a mercury vapor, xenon or other fluorescent light source, etc.) to produce a light output capable of causing the object to fluoresce. Alternately, a separate UV light source, combined with a visible-light-blocking filter, may be used to illuminate the object. Such a UV light source may be combined with light from a red LED (for example) in order to provide a visual indication of when the UV light is on and also to serve as an aid for the directional positioning of the probe operating with such a light source. A second measurement may be

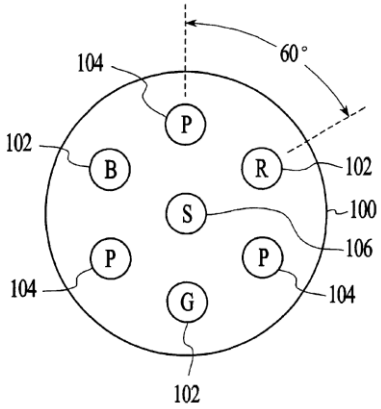
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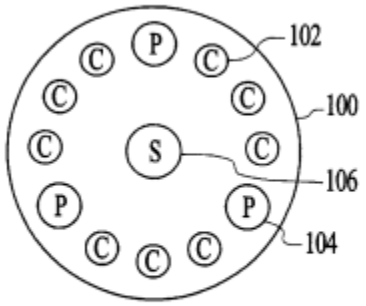
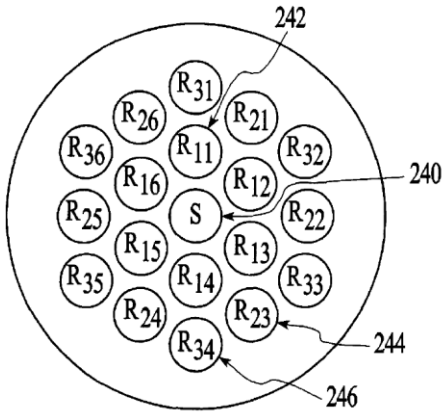
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	taken using the UV light source in a manner analogous to that described earlier, with the band of the red LED or other supplemental light source being ignored. The second measurement may thus be used to produce an indication of the fluorescence of the tooth or other object being measured. With such a UV light source, a silica fiber optic (or other suitable material) typically would be required to transmit the light to the object (standard fiber optic materials such as glass and plastic in general do not propagate UV light in a desired manner, etc.). Jung at 15:33-61. Light conduit 340 in this embodiment serves to conduct light from the light source to the surface of the object being measured, and also to receive reflected light from the surface and conduct it to light receiver fiber optics 346 in probe handle 344. Light conduit 340 is held in position with respect to fiber optics 346 by way or compression jaws 342 or other suitable fitting or coupled that reliably positions light conduit 340 so as to couple light effectively to/from fiber optics 346. Fiber optics 346 may be separated into separate fibers/light conduits 348, which may be coupled to appropriate light sensors, etc., as with previously described embodiments. Jung at 22:65-23:9. Referring again to FIG. 41A, light source 638 may be coupled to certain of sensors 676 through light path 674. Light bias, such as previously described, may be provided from the light source, or alternatively, from separately provided LED 680, which may couple light to certain of sensors 676 for providing controllable light bias to sensors 676 through light conduit 678. Jung at 53:65-54:4. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

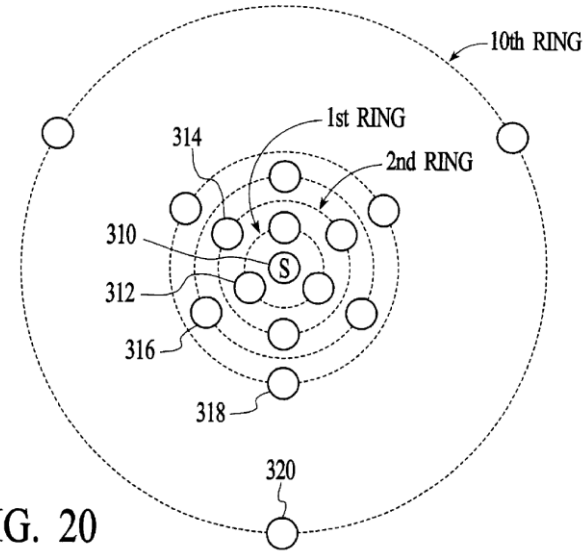
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	Claim 15
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Jung discloses or renders obvious wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above.  R - LIGHT RECEIVER FIBER OPTICS S - LIGHT SOURCE FIBER OPTIC FIG. 2 Jung at Fig. 2.

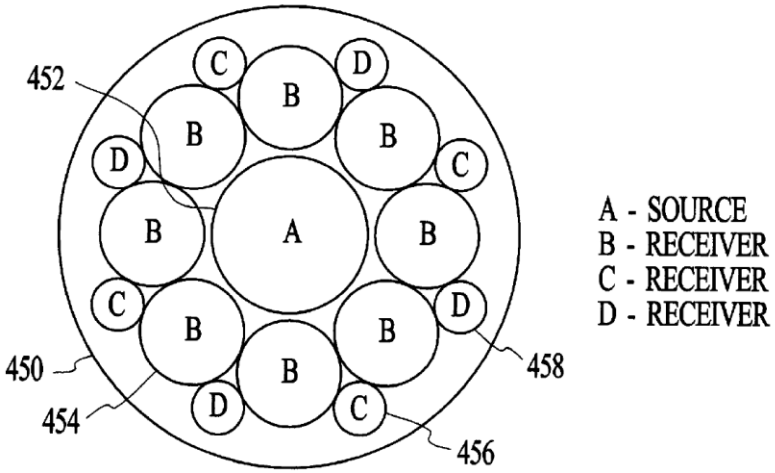
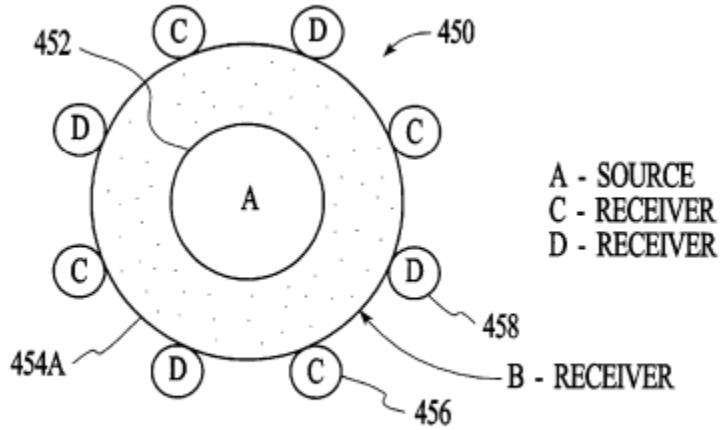
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	 S - LIGHT SOURCE FIBER R - RED RECEIVER G - GREEN RECEIVER B - BLUE RECEIVER P - NEUTRAL (FULL BAND) RECEIVERS FIG. 9 Jung at Fig. 9.

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	 FIG. 10A S - LIGHT SOURCE FIBER P - NEUTRAL (FULL BAND) RECEIVER C - COLOR RECEIVER Jung at Fig. 10a.  FIG. 10B S - LIGHT SOURCE FIBER R_{1X} - INNER RING RECEIVER FIBER R_{2X} - 2nd RING RECEIVER FIBER R_{3X} - 3rd RING RECEIVER FIBER

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	Jung at 10b.  FIG. 20 Jung at Fig. 20.

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	 FIG. 28A Jung at Fig. 28A.  FIG. 28B Jung at Fig. 28b.

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	In the illustrated embodiment, receiver fiber optics R1 to R3 are positioned symmetrically around source fiber optic S, with a spacing of about 120 degrees from each other. It should be noted that spacing t is provided between receiver fiber optics R1 to R3 and source fiber optic S. While the precise angular placement of the receiver fiber optics around the perimeter of the fiber bundle in general is not critical, it has been determined that three receiver fiber optics positioned 120 degrees apart generally may give acceptable results. As discussed above, in certain embodiments light receiver fiber optics R1 to R3 each constitute a single fiber, which is divided at splicing connector 4 (refer again to FIG. 1), or, in alternate embodiments, light receiver fiber optics R1 to R3 each constitute a bundle of fibers, numbering, for example, at least five fibers per bundle. It has been determined that, with available fibers of uniform size, a bundle of, for example, seven fibers may be readily produced (although as will be apparent to one of skill in the art, the precise number of fibers may be determined in view of the desired number of receiver fiber optics, manufacturing considerations, etc.). The use of light receiver fiber optics R1 to R3 to produce color/optical measurements is further described elsewhere herein, although it may be noted here that receiver fiber optics R1 to R3 may serve to detect whether, for example, the angle of probe tip 1 with respect to the surface of the object being measured is at 90 degrees, or if the surface of the object being measured contains surface texture and/or spectral irregularities. In the case where probe tip 1 is perpendicular to the surface of the object being measured and the surface of the object being measured is a diffuse reflector (i.e., a matte-type reflector, as compared to a glossy or spectral or shiny-type reflector which may have “hot spots”), then the light intensity input into the perimeter fibers should be approximately equal. It also should be noted that spacing t serves to adjust the optimal height at which color/optical measurements should be made (as more fully described below). Preferred embodiments, as described hereinafter, may enable the quantification of the gloss or degree of spectral reflection of the object being measured. Jung at 11:41-12:13. Probe tip 100 includes central source fiber optic 106, surrounded by (and spaced apart from) three perimeter receiver fiber optics 104 and three color receiver fiber optics 102. Three perimeter receiver fiber optics 104 are optically coupled to neutral density filters and serve as height/angle sensors in a manner analogous to the embodiment describe above. Three color receiver fiber optics are optically coupled to suitable tristimulus filters, such as red, green and blue filters. With this embodiment, a measurement may be made of tristimulus color values of the object, and the process described with reference to FIG. 6 generally is applicable to this embodiment. In particular, perimeter fiber optics 104

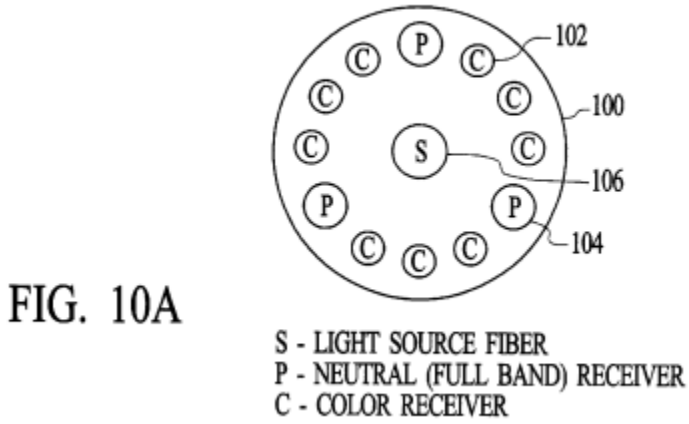
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	may be used to detect simultaneous peaking or otherwise whether the probe is perpendicular to the object being measured. Jung at 24:24-38. FIG. 10A illustrates another such embodiment, similar to the embodiment discussed with reference to FIG. 9. Probe tip 100 includes central source fiber optic 106, surrounded by (and spaced apart from) three perimeter receiver fiber optics 104 and a plurality of color receiver fiber optics 102. The number of color receiver fiber optics 102, and the filters associated with such receiver fiber optics 102, may be chosen based upon the particular application. As with the embodiment of FIG. 9, the process described with reference to FIG. 6 generally is applicable to this embodiment. FIG. 10B illustrates another such embodiment in which there are a plurality of receiver fiber optics that surround central source fiber optic 240. The receiver fiber optics are arranged in rings surrounding the central source fiber optic. FIG. 10B illustrates three rings of receiver fiber optics (consisting of fiber optics 242, 244 and 246, respectively), in which there are six receiver fiber optics per ring. The rings may be arranged in successive larger circles as illustrated to cover the entire area of the end of the probe, with the distance from each receiver fiber optic within a given ring to the central fiber optic being equal (or approximately so). Central fiber optic 240 is utilized as the light source fiber optic and is connected to the light source in a manner similar to light source fiber optic 5 illustrated in FIG. 1. Jung at 24:39-62. FIG. 20 illustrates such a further embodiment. The probe of this embodiment includes a plurality of perimeter sensors and a plurality of color sensors coupled to receivers 312-320. The color sensors and related components, etc., may be constructed to operate in a manner analogous to previously described embodiments. For example, fiber optic cables or the like may couple light from source 310 that is received by receivers 312-320 to sharp cut-off filters or to notch filters, with the received light measured over precisely defined wavelengths (see, e.g., FIGS. 1, 3 and 11-14 and related description). Jung at 32:66-33:9. Referring to FIG. 28A, a probe utilizing variable aperture receivers will now be described. In FIG. 28A, source A 452 represents a source fiber optic of a small numerical aperture NA, 0.25 for example; receivers B 454 represent receiver fiber optics of a wider numerical aperture, 0.5 for example;

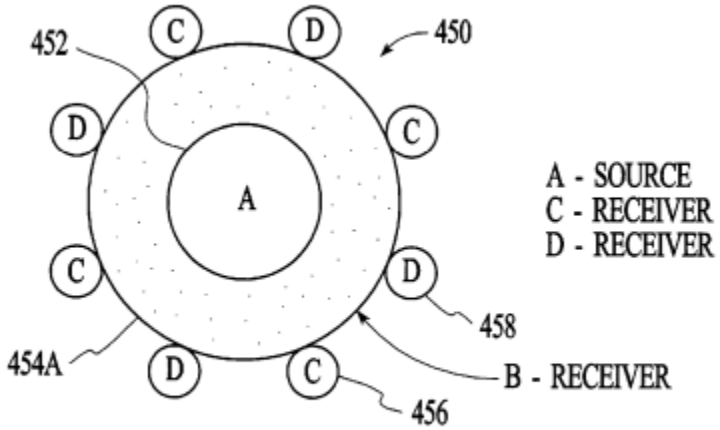
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	receivers C 456 represent receiver fiber optics of the same numerical aperture as source A but is shown with a smaller core diameter; and receivers D 458 represent receiver fiber optics of a wider numerical aperture, 0.5 for example. One or more of receiver(s) B 454 (in certain embodiments one receiver B may be utilized, while in other embodiments a plurality of receivers B are utilized, which may be circularly arranged around source A, such as 6 or 8 such receivers B) pass to a spectrometer (see, e.g., FIGS. 1, 3, 11, 12, configured as appropriate for such preferred embodiments). Receiver(s) B 454 are used to measure the spectrum of the reflected light. Receivers C 456 and D 458 pass to broad band (wavelength) optical receivers and are used to correct the measurement made by receiver(s) B. Receivers C 456 and D 458 are used to correct for and to detect whether or not the probe is perpendicular to the surface and to measure/assess the degree of specular versus diffuse reflection (the coefficient of specular reflection, etc.) and to measure the translucency of the material/object. FIG. 28B illustrates a refinement of the embodiment of FIG. 28A, in which receivers B 454 are replaced by a cylindrical arrangement of closely packed, fine optical fibers 454A, which generally surround light source 452 as illustrated. The fibers forming the cylindrical arrangement for receivers B 454, are divided into smaller groups of fibers and are presented, for example, to light sensors 8 shown in FIG. 1. The number of groups of fibers is determined by the number of light sensors. Alternately, the entire bundle of receiver fibers B 454 is presented to a spectrometer such as a diffraction grating spectrometer of conventional design. As previously described, receivers C 456 and D 458 may be arranged on the periphery thereof. In certain embodiments, receivers C and D may also consist of bundles of closely packed, fine optical fibers. In other embodiments they consist of single fiber optics. Jung at 39:41-40:14. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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	Claim 16
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Jung discloses or renders obvious wherein the first arc and the second arc are concentric. *See* claim 15 above.  FIG. 10A Jung at Fig. 10a.

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	 FIG. 28B Jung at Fig. 28b In the illustrated embodiment, receiver fiber optics R1 to R3 are positioned symmetrically around source fiber optic S, with a spacing of about 120 degrees from each other. It should be noted that spacing t is provided between receiver fiber optics R1 to R3 and source fiber optic S. While the precise angular placement of the receiver fiber optics around the perimeter of the fiber bundle in general is not critical, it has been determined that three receiver fiber optics positioned 120 degrees apart generally may give acceptable results. As discussed above, in certain embodiments light receiver fiber optics R1 to R3 each constitute a single fiber, which is divided at splicing connector 4 (refer again to FIG. 1), or, in alternate embodiments, light receiver fiber optics R1 to R3 each constitute a bundle of fibers, numbering, for example, at least five fibers per bundle. It has been determined that, with available fibers of uniform size, a bundle of, for example, seven fibers may be readily produced (although as will be apparent to one of skill in the art, the precise number of fibers may be determined in view of the desired number of receiver fiber optics, manufacturing considerations, etc.). The use of light receiver fiber optics R1 to R3 to produce color/optical measurements is further described elsewhere herein, although it may be noted here that receiver fiber optics R1 to R3 may serve to detect whether, for example, the angle of probe tip 1 with respect to the surface of the object being measured is at 90 degrees, or if the surface of the object being measured contains surface texture and/or spectral irregularities. In the case where probe tip 1 is perpendicular to the surface of the object being measured and the surface of the object being measured

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	is a diffuse reflector (i.e., a matte-type reflector, as compared to a glossy or spectral or shiny-type reflector which may have “hot spots”), then the light intensity input into the perimeter fibers should be approximately equal. It also should be noted that spacing t serves to adjust the optimal height at which color/optical measurements should be made (as more fully described below). Preferred embodiments, as described hereinafter, may enable the quantification of the gloss or degree of spectral reflection of the object being measured. Jung at 11:41-12:13. Probe tip 100 includes central source fiber optic 106, surrounded by (and spaced apart from) three perimeter receiver fiber optics 104 and three color receiver fiber optics 102. Three perimeter receiver fiber optics 104 are optically coupled to neutral density filters and serve as height/angle sensors in a manner analogous to the embodiment describe above. Three color receiver fiber optics are optically coupled to suitable tristimulus filters, such as red, green and blue filters. With this embodiment, a measurement may be made of tristimulus color values of the object, and the process described with reference to FIG. 6 generally is applicable to this embodiment. In particular, perimeter fiber optics 104 may be used to detect simultaneous peaking or otherwise whether the probe is perpendicular to the object being measured. Jung at 24:24-38. FIG. 10A illustrates another such embodiment, similar to the embodiment discussed with reference to FIG. 9. Probe tip 100 includes central source fiber optic 106, surrounded by (and spaced apart from) three perimeter receiver fiber optics 104 and a plurality of color receiver fiber optics 102. The number of color receiver fiber optics 102, and the filters associated with such receiver fiber optics 102, may be chosen based upon the particular application. As with the embodiment of FIG. 9, the process described with reference to FIG. 6 generally is applicable to this embodiment. Jung at 24:39-48. FIG. 28B illustrates a refinement of the embodiment of FIG. 28A, in which receivers B 454 are replaced by a cylindrical arrangement of closely packed, fine optical fibers 454A, which generally surround light source 452 as illustrated. The fibers forming the cylindrical arrangement for receivers B 454, are divided into smaller groups of fibers and are presented, for example, to light sensors 8 shown in FIG. 1. The

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	number of groups of fibers is determined by the number of light sensors. Alternately, the entire bundle of receiver fibers B 454 is presented to a spectrometer such as a diffraction grating spectrometer of conventional design. As previously described, receivers C 456 and D 458 may be arranged on the periphery thereof. In certain embodiments, receivers C and D may also consist of bundles of closely packed, fine optical fibers. In other embodiments they consist of single fiber optics. Jung at 39:66-40:14. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Jung discloses or renders obvious a wearable device for use with a smart phone or tablet. *See* claim 11[a], 11[k] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for	Jung discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* claim 11[a] above.

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measuring one or more physiological parameters,	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Jung disclose or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelength. Probe tip 1 encloses a plurality of fiber optics, each of which may constitute one or more fiber optic fibers. In a preferred embodiment, the fiber optics contained within probe tip 1 includes a single light source fiber optic and a number of groups of light receiver fiber optics. The use of such fiber optics to measure the color or other optical characteristics of an object will be described later herein. Probe tip 1 is attached to probe body 2, on which is fixed switch 17. Switch 17 communicates with microprocessor 10 through wire 18 and provides, for example, a mechanism by which an operator may activate the device in order to make a color/optical measurement. Fiber optics within probe tip 1 terminate at the forward end thereof (i.e., the end away from probe body 2). The forward end of probe tip 1 is directed towards the surface of the object to be measured as described more fully below. The fiber optics within probe tip 1 optically extend through probe body 2 and through fiber optic cable 3 to light sensors 8, which are coupled to microprocessor 10. Jung at 8:47-65 It is known that certain objects such as human teeth may fluoresce, and such optical characteristics also may be measured in accordance with the present invention. A light source with an ultraviolet component may be used to produce more accurate color/optical data with respect to such objects. Such data may be utilized to adjust the amounts and or proportions or types of dental fluorescing materials in dental restorations or prosthesis. In certain embodiments, a tungsten/halogen source (such as used in a preferred embodiment) may be combined with a UV light source (such as a mercury vapor, xenon or other fluorescent light source, etc.) to produce a light output capable of causing the object to fluoresce.

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	Alternately, a separate UV light source, combined with a visible-light-blocking filter, may be used to illuminate the object. Such a UV light source may be combined with light from a red LED (for example) in order to provide a visual indication of when the UV light is on and also to serve as an aid for the directional positioning of the probe operating with such a light source. A second measurement may be taken using the UV light source in a manner analogous to that described earlier, with the band of the red LED or other supplemental light source being ignored. The second measurement may thus be used to produce an indication of the fluorescence of the tooth or other object being measured. With such a UV light source, a silica fiber optic (or other suitable material) typically would be required to transmit the light to the object (standard fiber optic materials such as glass and plastic in general do not propagate UV light in a desired manner, etc.). Jung at 15:33-61 Referring again to FIG. 41A, light source 638 may be coupled to certain of sensors 676 through light path 674. Light bias, such as previously described, may be provided from the light source, or alternatively, from separately provided LED 680, which may couple light to certain of sensors 676 for providing controllable light bias to sensors 676 through light conduit 678. Jung at 53:65-54:4 In certain situations, a long time may be required for the light source and for the light bias source to stabilize. In other situations, the light source and bias source may drift. In preferred embodiments, the light source is a 18 W, 3300 K halogen stabilized tungsten filament lamp manufactured by Welch Allyn, Inc. The light bias preferably is provided by a high intensity LED and a fiber optic light guide or conduit (see LED 680 and light conduit 678 of FIG. 41A) that passes to each biased sensor of sensors 676. The intensity of LED 680 preferably is controlled and varied with high frequency pulse width modulation, or by analog constant current controllers. By controlling the intensity of bias LED 680, the bias light level can be varied to best match the sensor sampling rate. Jung at 56:34-47 In preferred embodiments utilizing this aspect of the present invention, the three monochromatic light source fibers are each supplied with monochromatic light of different wavelengths. One preferred way to provide such monochromatic light is by utilizing three infra-red LEDs of different wavelengths, for

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	example, or by filtering a white light source with interference notch filters with different center wavelengths. Jung at 66:58-65 In one such preferred embodiment, a broad band white light source supplies light to all light source fibers/light guides. Light supplied to the three monochromatic light sources is filtered with narrow band pass notch filters with center wavelengths greater than 700 nanometers. For example, one center wavelength may be 750 nanometers, while another center wavelength may be 775 nanometers, and a third center wavelength may be 800 nanometers. It should be noted that the exact filter wavelengths are not important; it is only important that such wavelengths be sufficiently different so that they do not overlap and may be separately detected, as described herein. The other two rings of light sources include, for example, a broad-band visible range filter that passes light from 400 to 700 nanometers and rejects light in the range of the three monochrome filters. What is important is the broad-band light sources preferably do not emit light in the frequency range of the monochromatic light sources, or at least do not emit light in such frequency range to a degree that would interfere with the detection of the monochromatic light as described herein. Jung at 66:66-67:17 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Jung discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* claim 11[c], 11[e], 19[a] above.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue.	Jung discloses or renders obvious the measurement device further comprising a receiver configured to:capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue. *See* claim 11[d], 11[h], 11[i], 19[a] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Jung discloses or renders obvious the receiver configure to synchronize to the modulation of the at least one of the semiconductor sources. *See* claim 11[a], 11[b], 11[g], 19[a], 19[b], 19[d] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Jung discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* claim 11[b], 11[h], 11[i], 11[j], 19[a], 19[d] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Jung discloses or renders obvious increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* claim 11[a] , 11[b], 19[a] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a	Jung discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* claim 19[a], 11[a], 11[f] above.

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non-invasive measurement on blood contained within the tissue;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Jung discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* claim 11[k], 19[pre] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link	Jung discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link. *See* claim 11[k], 19[pre] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Jung discloses or renders obvious wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 13, 19 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Jung discloses or renders obvious wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Jung discloses or renders obvious wherein the first arc and the second arc are concentric. *See* claim 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D5

U.S. Pat. No. 10,874,304 in view of WO Patent Publication No. 2012/099536 to Md. Irwan bin Kassim Md at el. ("Kassim")

As described in detail below, Kassim (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D4 and D6-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. . This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Kassim. The cited portions of Kassim are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Kassim. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Kassim "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Kassim does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Kassim (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Kassim anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

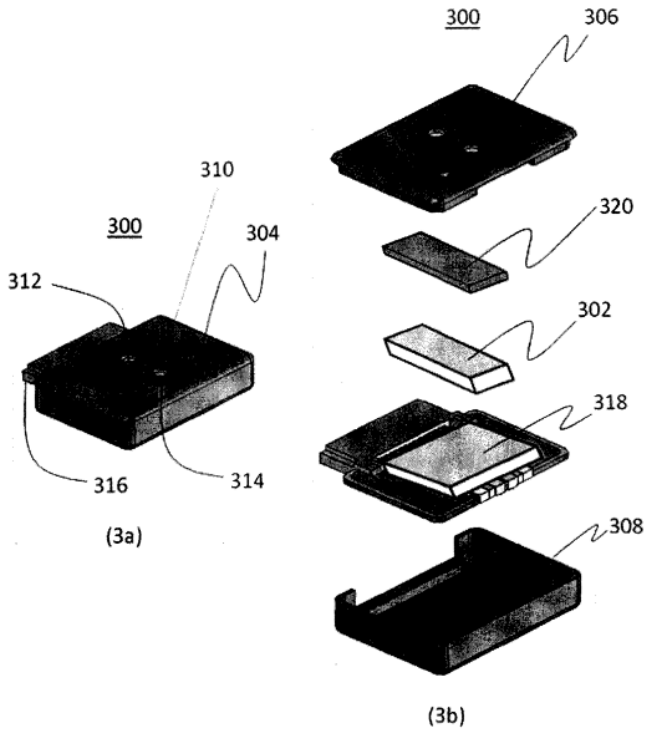
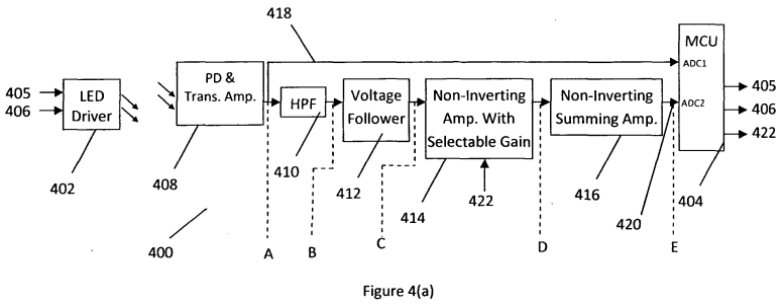
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 11	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kassim discloses or renders obvious a measurement system. The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculationsubtracs/measurements. Kassim at 8:24-28 In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpQ2 values determination. Before proceeding to more fully describe some example embodiments, it may be beneficial to briefly describe components of a PPG signal. Kassim at 8:30-34 In one exemplary embodiment, the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is not exhaustive by any means. However, the feedback unit may not need to be portable, and could similarly be a computer or server. The feedback unit may be connected with the device 300 in a wired or wireless fashion, or through a proprietary connector, such a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA). Kassim at 12:12-18 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used,

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	for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. Kassim at 12:27-33. Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Figure 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Figure 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Figure 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33

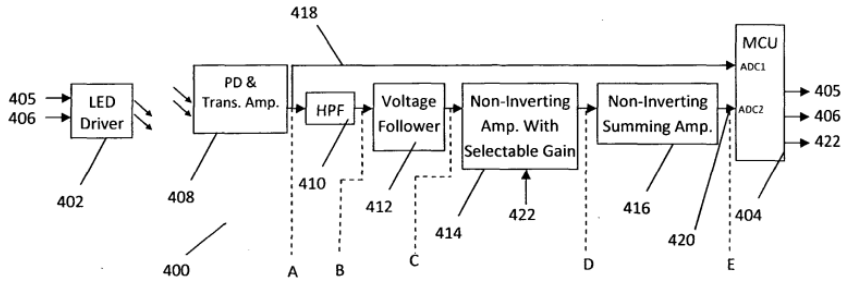
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	 Figure 3 Kassim at Fig. 3  Figure 4(a) Kassim at Fig. 4(a)

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Kassim discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpQ2 values determination. Before proceeding to more fully describe some example embodiments, it may be beneficial to briefly describe components of a PPG signal. Kassim at 8:30-34 In some example embodiments, saturation of peripheral oxygen (SP02) information of a user is derivable from detected output light information from both a red LED and an infra-red LED. Further, in the description herein, the term "light" as used herein is meant to be interpreted in a broad sense and is not limited to visible light only. The term "light" as used herein can include, but is not limited to, X-ray light rays, visible light rays, ultraviolet light rays and infra-red light rays. Kassim at 11:23-28 Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Figure 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Figure 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402

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	can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Figure 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33  Figure 4(a) Kassim at Fig. 4(a) One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Kassim discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. It is appreciated that the detected light information or Vppg signal e.g. to be transmitted to a personal mobile processing device for further processing has a substantial extent of ambient light interference. Therefore, ambient light or noise cancellation can be performed e.g. at the personal mobile processing device. The description below relating to ambient noise cancellation for SP02 calculations can be implemented through software and/or hardware modules. The hardware modules can comprise electronic circuitry or dedicated application chips such as an ASIC chip. A graphical user interface (GUI) may be provided, such as an "app" or software application on a smartphone, to be run on the personal mobile processing device to implement and display the ambient noise cancellation. Kassim at 21:33-22:6 In example embodiments, there can be provided a method and system for noise cancellation, e.g. for Sp02 measurements. In one example embodiment, AC and DC values are respectively obtained for a Red PPG signal measurement, an IR PPG signal measurement and an ambient PPG signal measurement (where both the red and IR LEDs are turned off). The maximum and minimum values of the PPG signal measurements are determined. A Sp02 value based on a ratio R value calculated using the determined maximum and minimum values can then be determined. Kassim at 22:19-25 Advantageously, in the example embodiment, a signal reconstruction of true Red and/or IR PPG signals to remove ambient signal interference can be avoided. The inventors have recognised that by identifying and utilising only significant information for Sp02 calculation, an efficient and accurate calculation can be carried out. The inventors have recognized that by using only the maximum and minimum values of the respective red, IR and ambient signal pulses, the calculation of Sp02 can be carried out. For example, a maximum of the true Red PPG signal (devoid of ambient noise) can simply be obtained by subtracting the obtained maximum value of the Red PPG signal, obtained when the Red LED is turned on, with the obtained maximum value of the ambient PPG signal, i.e. when none of the LEDs is turned on. Kassim at 22:27-23-3

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	In other words, instead of reconstructing a true Red PPG signal (devoid of ambient signal) and a true IR PPG signal (devoid of ambient signal), advantageously, reconstruction is avoided in example embodiments, and only the maximum and minimum values of 3 PPG signals are obtained for analysis to obtain Sp02 value. This can minimise processing and consume less power. Kassim at 23:5-9 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21 Figure 18 is a schematic flow diagram illustrating a light intensity setting process in an example embodiment. This process can be used for scenarios for normal measurements. At step 1802, a LED toggle sequence is performed. At step 1804, the light data detected at step 1802 undergoes a gain process. The gain may be selected from, for example, ten times, twenty times or thirty times etc. In the example embodiment, a gain of e.g. ten times is selected. At step 1806, it is determined whether ADC1 of the MCU of the measurement device reads a value of e.g. about 2.5V. The LEDs intensity is adjusted until the reading reaches 2.5V. This can ensure that the contribution of the ambient light is not substantially more than the contribution of the LEDs, when measured by the detector. In this example embodiment, because the ambient light cannot exceed 1.5V, and each LED is adjusted to result in a measurement of about 2.5V, the ambient light does not exceed more than about 60% of the light detected by the detector, when each LED is switched on. At step 1808, it is determined whether ADC2 of the MCU of the measurement device reaches saturation, e.g. at about 3.3V. If ADC2 has reached saturation, at step 1810, the LEDs intensity is lowered until ADC2 is no longer saturated at step 1812.

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	Kassim at 33:1-16 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Kassim discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpQ2 values determination. Before proceeding to more fully describe some example embodiments, it may be beneficial to briefly describe components of a PPG signal. Kassim at 8:30-34 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Figure 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Figure 4(c) is a schematic block drawing illustrating a non-inverting amplifier

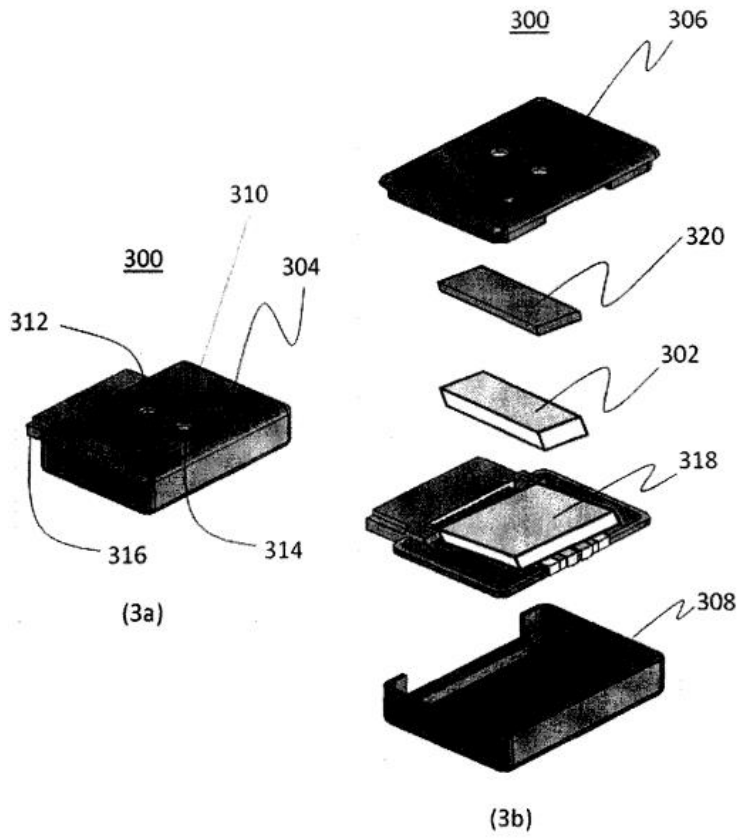
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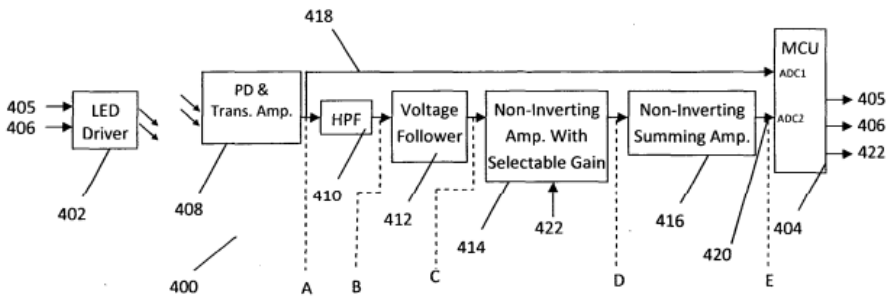
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	with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Figure 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d]. the wearable measurement device further comprising a receiver configured to:	Kassim discloses or renders obvious the wearable measurement device further comprising a receiver. The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Figure 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between

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	the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 11:34-12:10 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Figure 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Figure 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Figure 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33

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	 Figure 3 Kassim at Fig. 3

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	 Figure 4(a) Kassim at Fig. 4(a) One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample	Kassim discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Figure 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc.

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	Kassim at 11:34-12:10 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Figure 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Figure 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Figure 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain.. Kassim at 13:14-33 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Kassim discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 During operation, at the output of the detection assembly 408, a raw PPG signal is recorded. This enables the DC component of the signal to be acquired e.g. for LED illumination intensity adjustment and Sp02 calculation. The high-pass filter 410 can introduce a filter with a high-pass cut off of e.g. about 0.12 Hz so as to remove the DC component of the raw PPG signal. This can also produce the AC component of the signal, with the AC component oscillating about ground voltage. The output of the high-pass filter 410 is transmitted to the voltage follower amplifier module 412 to create a high impedance signal. The inventors have recognised that without a high impedance, the signal may be lost at the amplification stage subsequently. Kassim at 14:11-19 Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Figure 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Figure 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405).

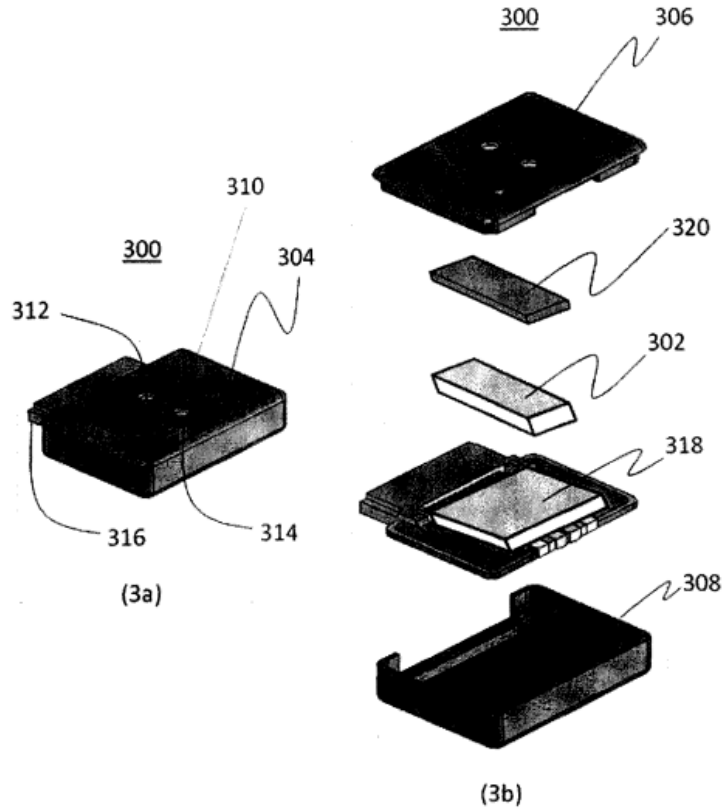
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	In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Figure 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	Kassim discloses or renders obvious the receiver configured to synchronize to the light source. In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Figure 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Figure 4(c) is a schematic block drawing illustrating a non-inverting amplifier

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	with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Figure 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33

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	 Figure 3 Kassim at Fig.3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

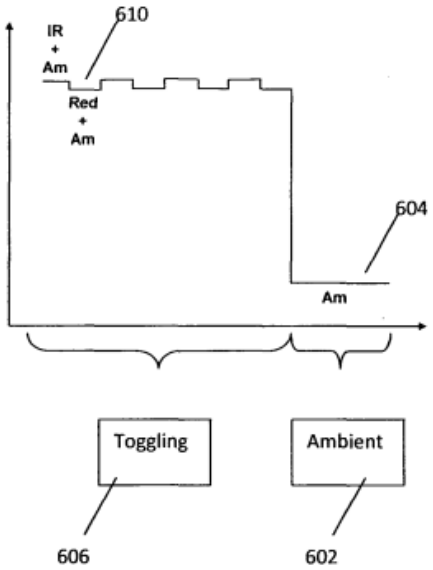
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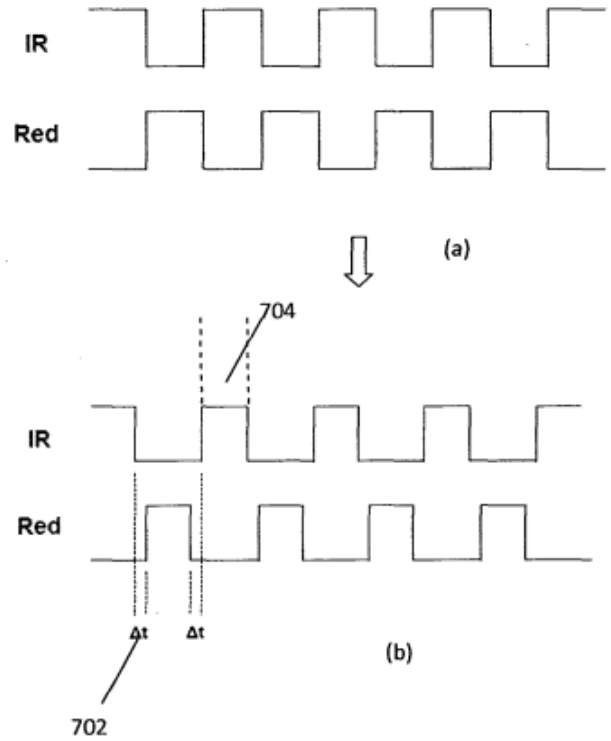
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11[h]. capture light while the semiconductor sources are off and convert the captured light into a first signal,	Kassim discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal. The light sources may be toggled on/off for the detection assembly to detect the reflected output light as a single signal. Kassim at 3:21-22 Figure 6(a) is a schematic graphical illustration of output obtained at a light detector (compare 408 of Figure 4) during a light emitting diode (LED) firing sequence in an example embodiment. During an Ambient (Am) or OFF condition 602, both the IR and RED LEDs are turned off, and an ambient PPG signal 604 can be obtained. During a toggling sequence 606, the IR and RED LEDs are alternatingly turned on. The MCU can then perform time based de-multiplexing to extract the respective IR and RED PPG signals. Kassim at 15:16-21 Figure 7(a) is an exemplary schematic timing wave diagram for toggling on/off of an IR LED and a Red LED. Figure 7(b) is an alternative schematic timing wave diagram for toggling on/off of an IR LED and a Red LED in an example embodiment. Figure 7(b) is a modification of Figure 7(a) to allow an ambient PPG signal to be obtained. Figure 7(b) also illustrates a toggling sequence within sequence 606 of Figure 6. There is a relatively brief period At 702 between each toggling, e.g. about I OOμε, when both the Red and IR LEDs are turned off. Each LED is turned on for about 2.9ms e.g. numeral 704, which makes each toggling cycle to be about 6ms. This can improve the IR and Red PPG signals accuracy. The brief period At 702 allows a time break between switching from a Red and IR signal condition (or vice versa). This may be useful to a single path system whereby detection of the red and IR signals are performed using the same circuitry, i.e. a single path system. The brief period At 702 introduced can ensure that each detected Red and IR light information displays its own behavior. The inventors have recognised that if there is no break e.g. provided by period At 702, the light signal of the previously switched on LED may still be present in the processing path. That is, using the brief period can reduce "crosstalk" issues. Kassim at 16:1-15

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	In example embodiments, there can be provided a method and system for noise cancellation, e.g. for Sp02 measurements. In one example embodiment, AC and DC values are respectively obtained for a Red PPG signal measurement, an IR PPG signal measurement and an ambient PPG signal measurement (where both the red and IR LEDs are turned off). The maximum and minimum values of the PPG signal measurements are determined. A Sp02 value based on a ratio R value calculated using the determined maximum and minimum values can then be determined. Kassim at 21:19-25 Figure 10(a) is a graph illustrating signals acquired at an analog to digital converter (compare ADC1 of Figure 4(a)) in an example embodiment. The y-axis is in terms of mV and the x-axis is in terms of ms. Numeral 002 shows the signals obtained when the Red and IR LEDs are turned on during the toggling sequence 606 (Figure 6(a)). Numeral 1004 shows the signals obtained when the Red and IR LEDs are turned off during the OFF condition 602 (Figure 6(a)). As shown, the amplitude of the signals obtained during the toggling sequence 606 (Figure 6) is notated as x'. Kassim at 23:23-29 Figure 10(b) is a graph illustrating AC signals acquired at an analog to digital converter (compare ADC2 of Figure 4(a)) in an example embodiment. The y-axis is in terms of mV and the x-axis is in terms of ms. Numeral 1006 shows the AC signals when the Red and IR LEDs are turned on during the toggling sequence 606 (Figure 6(a)). Numeral 1008 shows the AC signals when the Red and IR LEDs are turned off during the OFF condition 602 (Figure 6(a)). The IR signals are shown with solid lines at 1010 and the Red signals are shown with dotted lines at 1012. With the amplification provided in Figure 4(a), as shown, the difference between the Red and IR detected AC signals is notated as 10x', i.e. a gain of about 10 times has been provided. Kassim at 23:31-24-4 Figure 17 is a schematic flow diagram illustrating an ambient light detection process in an example embodiment. An optical measurement device is coupled to a personal mobile processing device. At step 1710, both the Red and IR LEDs are switched off. At step 1712, it is determined whether ADC1 of the MCU of the measurement device reads a value of e.g. more than about 1.5V. If the reading is more than

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	the exemplary value of 1.5V at step 1712, at step 1714, the personal mobile processing device is configured to alert the user to relocate to another location for the optical measurement as the ambient light interference is determined to be too high. If the reading is less than the exemplary value of 1.5V at step 1712, at step 1716, the ambient light detection process ends. Kassim at 32:27-35  Figure 6(a) Kassim at Fig. 6(a)

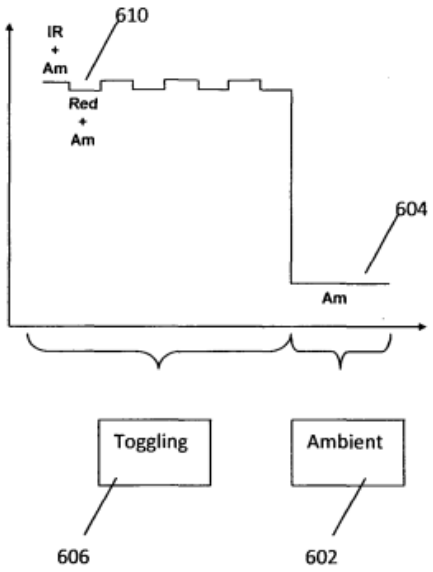
’304 Patent	Kassim
	 Kassim at Fig 7(a) &7(b) One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the	Kassim discloses or renders obvious the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light

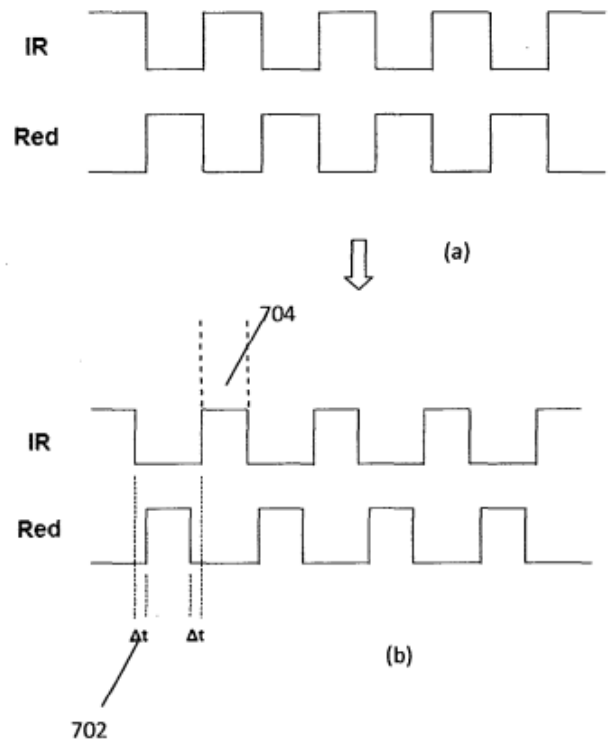
’304 Patent	Kassim
semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. The light sources may be toggled on/off for the detection assembly to detect the reflected output light as a single signal. Kassim at 3:21-22 Figure 6(a) is a schematic graphical illustration of output obtained at a light detector (compare 408 of Figure 4) during a light emitting diode (LED) firing sequence in an example embodiment. During an Ambient (Am) or OFF condition 602, both the IR and RED LEDs are turned off, and an ambient PPG signal 604 can be obtained. During a toggling sequence 606, the IR and RED LEDs are alternatingly turned on. The MCU can then perform time based de-multiplexing to extract the respective IR and RED PPG signals. Kassim at 15:16-21 Figure 7(a) is an exemplary schematic timing wave diagram for toggling on/off of an IR LED and a Red LED. Figure 7(b) is an alternative schematic timing wave diagram for toggling on/off of an IR LED and a Red LED in an example embodiment. Figure 7(b) is a modification of Figure 7(a) to allow an ambient PPG signal to be obtained. Figure 7(b) also illustrates a toggling sequence within sequence 606 of Figure 6. There is a relatively brief period At 702 between each toggling, e.g. about I OOμε, when both the Red and IR LEDs are turned off. Each LED is turned on for about 2.9ms e.g. numeral 704, which makes each toggling cycle to be about 6ms. This can improve the IR and Red PPG signals accuracy. The brief period At 702 allows a time break between switching from a Red and IR signal condition (or vice versa). This may be useful to a single path system whereby detection of the red and IR signals are performed using the same circuitry, i.e. a single path system. The brief period At 702 introduced can ensure that each detected Red and IR light information displays its own behavior. The inventors have recognised that if there is no break e.g. provided by period At 702, the light signal of the previously switched on LED may still be present in the processing path. That is, using the brief period can reduce "crosstalk" issues. Kassim at 16:1-15

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	Figure 10(a) is a graph illustrating signals acquired at an analog to digital converter (compare ADC1 of Figure 4(a)) in an example embodiment. The y-axis is in terms of mV and the x-axis is in terms of ms. Numeral 002 shows the signals obtained when the Red and IR LEDs are turned on during the toggling sequence 606 (Figure 6(a)). Numeral 1004 shows the signals obtained when the Red and IR LEDs are turned off during the OFF condition 602 (Figure 6(a)). As shown, the amplitude of the signals obtained during the toggling sequence 606 (Figure 6) is notated as x'. Kassim at 23:23-29 Figure 10(b) is a graph illustrating AC signals acquired at an analog to digital converter (compare ADC2 of Figure 4(a)) in an example embodiment. The y-axis is in terms of mV and the x-axis is in terms of ms. Numeral 1006 shows the AC signals when the Red and IR LEDs are turned on during the toggling sequence 606 (Figure 6(a)). Numeral 1008 shows the AC signals when the Red and IR LEDs are turned off during the OFF condition 602 (Figure 6(a)). The IR signals are shown with solid lines at 1010 and the Red signals are shown with dotted lines at 1012. With the amplification provided in Figure 4(a), as shown, the difference between the Red and IR detected AC signals is notated as 10x', i.e. a gain of about 10 times has been provided. Kassim at 23:31-24-4

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	 Figure 6(a) Kassim at Fig. 6(a)

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	 Kassim at Fig 7(a) &7(b) One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j]. wherein the measurement system is	Kassim discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal.

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further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	It is appreciated that the detected light information or Vppg signal e.g. to be transmitted to a personal mobile processing device for further processing has a substantial extent of ambient light interference. Therefore, ambient light or noise cancellation can be performed e.g. at the personal mobile processing device. The description below relating to ambient noise cancellation for SP02 calculations can be implemented through software and/or hardware modules. The hardware modules can comprise electronic circuitry or dedicated application chips such as an ASIC chip. A graphical user interface (GUI) may be provided, such as an "app" or software application on a smartphone, to be run on the personal mobile processing device to implement and display the ambient noise cancellation. Kassim at 21:33-22:6 Advantageously, in the example embodiment, a signal reconstruction of true Red and/or IR PPG signals to remove ambient signal interference can be avoided. The inventors have recognised that by identifying and utilising only significant information for Sp02 calculation, an efficient and accurate calculation can be carried out. The inventors have recognized that by using only the maximum and minimum values of the respective red, IR and ambient signal pulses, the calculation of Sp02 can be carried out. For example, a maximum of the true Red PPG signal (devoid of ambient noise) can simply be obtained by subtracting the obtained maximum value of the Red PPG signal, obtained when the Red LED is turned on, with the obtained maximum value of the ambient PPG signal, i.e. when none of the LEDs is turned on. Kassim at 22:27-23-3 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms.

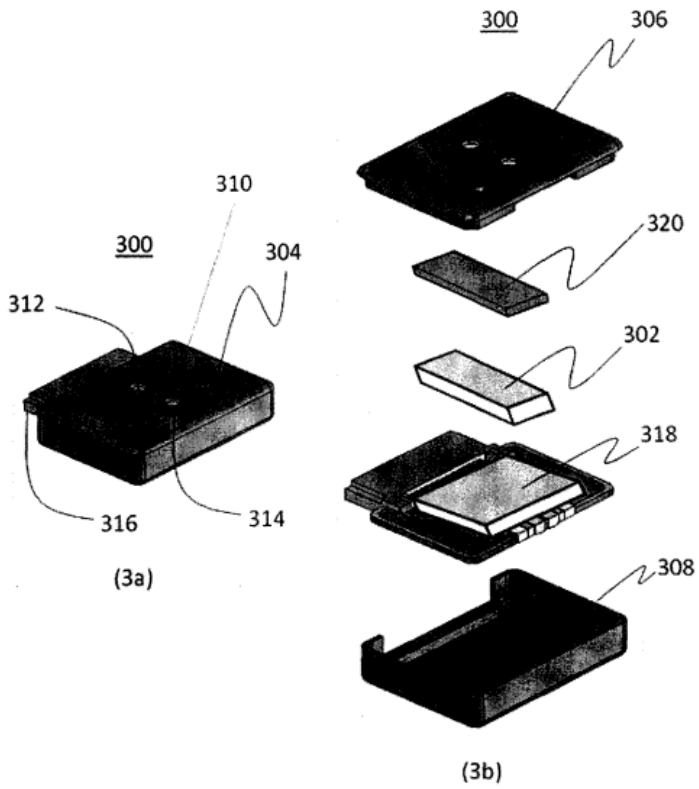
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	Kassim at 23:11-21 Therefore, it can be derived that avg In another example embodiment, the ratio R can be determined using averages of maximum and minimum values. In the example embodiment, each Red and IR PPG signal are paired on a per cycle basis. A subtraction is carried out using an average ambient signal value. The average ambient signal value can be obtained before or after obtaining the Red and IR PPG signals. Kassim at 30:17-24 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	Kassim discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpQ2 values determination. Before proceeding to more fully describe some example embodiments, it may be beneficial to briefly describe components of a PPG signal. Kassim at 8:30-34

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	The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Figure 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 11:34-12:10 In one exemplary embodiment, the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is not exhaustive by any means. However, the feedback unit may not need to be portable, and could similarly be a computer or server. The feedback unit may be connected with the device 300 in a wired or wireless fashion, or through a proprietary connector, such a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA). Kassim at 12:12-18 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 It is appreciated that the detected light information or Vppg signal e.g. to be transmitted to a personal mobile processing device for further processing has a substantial extent of ambient light interference. Therefore, ambient light or noise cancellation can be performed e.g. at the personal mobile processing

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	device. The description below relating to ambient noise cancellation for SP02 calculations can be implemented through software and/or hardware modules. The hardware modules can comprise electronic circuitry or dedicated application chips such as an ASIC chip. A graphical user interface (GUI) may be provided, such as an "app" or software application on a smartphone, to be run on the personal mobile processing device to implement and display the ambient noise cancellation. Kassim at 21:33-22:6 The inventors have recognised that, indirectly, deviation oR reflects the confidence level of the computation result of R. The calculated propagation error may be displayed on a screen of a personal mobile processing device to inform the user of the potential accuracy of the Sp02 measurement. Kassim at 29:10-13 With the ratio R, Sp02 or the saturation of hemoglobin with oxygen (in blood) can be determined. That is, in some examples, the ratio R can be used to refer to a proprietary lookup table provided by a manufacturer to determine the corresponding Sp02 value. The lookup table can be stored in a database that is in turn loaded onto the personal mobile processing device and the lookup operation is automated. Kassim at 28:22-26

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	 Figure 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless	Kassim discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received

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transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpQ2 values determination. Before proceeding to more fully describe some example embodiments, it may be beneficial to briefly describe components of a PPG signal. Kassim at 8:30-34 The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Figure 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 11:34-12:10 In one exemplary embodiment, the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is not exhaustive by any means. However, the feedback unit may not need to be portable, and could similarly be a computer or server. The feedback unit may be connected with the device 300 in a wired or wireless fashion, or through a proprietary connector, such a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA). Kassim at 12:12-18

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	In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 Figure 20 is a block diagram that illustrates an embodiment of a computer/server system 2000 upon which an embodiment of the inventive methodology may be implemented. The system 2000 includes a computer/server platform 2001 including a processor 2002 and memory 2003 which operate to execute instructions, as known to one of skill in the art. The term "computer-readable medium" as used herein refers to any medium that participates in providing instructions to processor 2002 for execution. Additionally, the computer platform 2001 receives input from a plurality of input devices 2004, such as a keyboard, mouse, touch device or verbal command. The computer platform 2001 may additionally be connected to a removable storage device 2005, such as a portable hard drive, optical media (CD or DVD), disk media or any other medium from which a computer can read executable code. The computer platform may further be connected to network resources 2006 which connect to the Internet or other components of a local public or private network. The network resources 2006 may provide instructions and data to the computer platform from a remote location on a network 2007. The connections to the network resources 2006 may be via wireless protocols, such as the 802.11 standards, Bluetooth® or cellular protocols, or via physical transmission media, such as cables or fiber optics. The network resources may include storage devices for storing data and executable instructions at a location separate from the computer platform 2001. The computer interacts with a display 2008 to output data and other information to a user, as well as to request additional instructions and input from the user. The display 2008 may therefore further act as an input device 2004 for interacting with a user. Kassim at 33:34-34:19 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kassim discloses or renders obvious wherein the measurement system is configured to use artificial intelligence in making decisions. In some example embodiments, saturation of peripheral oxygen (SP02) information of a user is derivable from detected output light information from both a red LED and an infra-red LED. Further, in the description herein, the term "light" as used herein is meant to be interpreted in a broad sense and is not limited to visible light only. The term "light" as used herein can include, but is not limited to, X-ray light rays, visible light rays, ultraviolet light rays and infra-red light rays. Kassim at 11:23-28 The description herein may be, in certain portions, explicitly or implicitly described as algorithms and/or functional operations that operate on data within a computer memory or an electronic circuit. These algorithmic descriptions and/or functional operations are usually used by those skilled in the information/data processing arts for efficient description. An algorithm is generally relating to a self-consistent sequence of steps leading to a desired result. The algorithmic steps can include physical manipulations of physical quantities, such as electrical, magnetic or optical signals capable of being stored, transmitted, transferred, combined, compared, and otherwise manipulated. Kassim at 10:6-13 Further, unless specifically stated otherwise, and would ordinarily be apparent from the following, a person skilled in the art will appreciate that throughout the present specification, discussions utilizing terms such as "scanning", "calculating", "determining", "replacing", "generating", "initializing", "outputting", and the like, refer to action and processes of a instructing processor/computer system, or similar electronic circuit/device/component, that manipulates/processes and transforms data represented as physical quantities within the described system into other data similarly represented as physical quantities within the system or other information storage, transmission or display devices etc

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	. Kassim at 10:15-22 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a]. wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Kassim discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. The description herein may be, in certain portions, explicitly or implicitly described as algorithms and/or functional operations that operate on data within a computer memory or an electronic circuit. These algorithmic descriptions and/or functional operations are usually used by those skilled in the information/data processing arts for efficient description. An algorithm is generally relating to a self-consistent sequence of steps leading to a desired result. The algorithmic steps can include physical manipulations of physical quantities, such as electrical, magnetic or optical signals capable of being stored, transmitted, transferred, combined, compared, and otherwise manipulated. Kassim at 10:6-13 Further, unless specifically stated otherwise, and would ordinarily be apparent from the following, a person skilled in the art will appreciate that throughout the present specification, discussions utilizing terms such as "scanning", "calculating", "determining", "replacing", "generating", "initializing", "outputting", and the like, refer to action and processes of a instructing processor/computer system, or similar electronic circuit/device/component, that manipulates/processes and transforms data represented as physical quantities within the described system into other data similarly represented as physical quantities within the system or other information storage, transmission or display devices etc. Kassim at 10:15-22

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	To determine Sp02 values, for example, a proprietary lookup table is typically provided by manufacturers. A calculated ratio R is used for referring to the lookup table to determine Sp02 values. R is defined as, Figure imgf000024_0001 where AC, DC refer to alternating current and direct current values respectively. The conditions IR and R refer to conditions whereby infra-red light and red light are used respectively. It is noted that ambient light noise is usually subtracted or removed in the R calculations. Kassim at 22:8-17 Advantageously, in the example embodiment, a signal reconstruction of true Red and/or IR PPG signals to remove ambient signal interference can be avoided. The inventors have recognised that by identifying and utilising only significant information for Sp02 calculation, an efficient and accurate calculation can be carried out. The inventors have recognized that by using only the maximum and minimum values of the respective red, IR and ambient signal pulses, the calculation of Sp02 can be carried out. For example, a maximum of the true Red PPG signal (devoid of ambient noise) can simply be obtained by subtracting the obtained maximum value of the Red PPG signal, obtained when the Red LED is turned on, with the obtained maximum value of the ambient PPG signal, i.e. when none of the LEDs is turned on. Kassim at 22:27-23-3 In other words, instead of reconstructing a true Red PPG signal (devoid of ambient signal) and a true IR PPG signal (devoid of ambient signal), advantageously, reconstruction is avoided in example embodiments, and only the maximum and minimum values of 3 PPG signals are obtained for analysis to obtain Sp02 value. This can minimise processing and consume less power. Kassim at 23:5-9 With the AC and DC signal portions, the inventors have recognised that significant information can be further extracted for Sp02 calculation. Using the circuit of Figure4(a), it can be seen from Figures 10(a) and (b) that the AC and DC components of the Red and IR PPG signals are larger than those of the ambient PPG signal. Therefore, the contribution of the ambient PPG signal is less significant compared with the contribution of the RED or IR PPG signals. This can provide for a more accurate Sp02

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	calculation. That is, in example embodiments, the LED illumination intensity can be tuned to a level that provides for detected signals that provide as high a detected voltage as possible, without saturating the signals. The intensity can be controlled by the MCU. The tuning can ensure that both Red and IR signals transmitted to ADC1 can reach an amplitude level significantly higher than Ambient signals transmitted to ADC1. For example, if an Ambient signal at ADC1 is about 0.5V, both Red and IR signals at ADC1 can preferably be set at about 2V or above. This is described and illustrated in more detail below with Figure 18. In addition, there can be steps taken to ensure that detected Ambient light signals are not too high. Exemplary steps are described and illustrated in more detail below with Figure 17. Kassim at 24:14-28 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Kassim discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. It is appreciated that the detected light information or Vppg signal e.g. to be transmitted to a personal mobile processing device for further processing has a substantial extent of ambient light interference. Therefore, ambient light or noise cancellation can be performed e.g. at the personal mobile processing device. The description below relating to ambient noise cancellation for SP02 calculations can be implemented through software and/or hardware modules. The hardware modules can comprise electronic circuitry or dedicated application chips such as an ASIC chip. A graphical user interface (GUI) may be provided, such as an "app" or software application on a smartphone, to be run on the personal mobile processing device to implement and display the ambient noise cancellation. Kassim at 21:33-22:6

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	In example embodiments, there can be provided a method and system for noise cancellation, e.g. for Sp02 measurements. In one example embodiment, AC and DC values are respectively obtained for a Red PPG signal measurement, an IR PPG signal measurement and an ambient PPG signal measurement (where both the red and IR LEDs are turned off). The maximum and minimum values of the PPG signal measurements are determined. A Sp02 value based on a ratio R value calculated using the determined maximum and minimum values can then be determined. Kassim at 22:19-25 Advantageously, in the example embodiment, a signal reconstruction of true Red and/or IR PPG signals to remove ambient signal interference can be avoided. The inventors have recognised that by identifying and utilising only significant information for Sp02 calculation, an efficient and accurate calculation can be carried out. The inventors have recognized that by using only the maximum and minimum values of the respective red, IR and ambient signal pulses, the calculation of Sp02 can be carried out. For example, a maximum of the true Red PPG signal (devoid of ambient noise) can simply be obtained by subtracting the obtained maximum value of the Red PPG signal, obtained when the Red LED is turned on, with the obtained maximum value of the ambient PPG signal, i.e. when none of the LEDs is turned on. Kassim at 22:27-23-3 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Kassim discloses or renders obvious the measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. It is appreciated that the detected light information or Vppg signal e.g. to be transmitted to a personal mobile processing device for further processing has a substantial extent of ambient light interference. Therefore, ambient light or noise cancellation can be performed e.g. at the personal mobile processing device. The description below relating to ambient noise cancellation for SP02 calculations can be implemented through software and/or hardware modules. The hardware modules can comprise electronic circuitry or dedicated application chips such as an ASIC chip. A graphical user interface (GUI) may be provided, such as an "app" or software application on a smartphone, to be run on the personal mobile processing device to implement and display the ambient noise cancellation. Kassim at 21:33-22:6 In example embodiments, there can be provided a method and system for noise cancellation, e.g. for Sp02 measurements. In one example embodiment, AC and DC values are respectively obtained for a Red PPG signal measurement, an IR PPG signal measurement and an ambient PPG signal measurement (where both the red and IR LEDs are turned off). The maximum and minimum values of the PPG signal measurements are determined. A Sp02 value based on a ratio R value calculated using the determined maximum and minimum values can then be determined. Kassim at 22:19-25

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	Advantageously, in the example embodiment, a signal reconstruction of true Red and/or IR PPG signals to remove ambient signal interference can be avoided. The inventors have recognised that by identifying and utilising only significant information for Sp02 calculation, an efficient and accurate calculation can be carried out. The inventors have recognized that by using only the maximum and minimum values of the respective red, IR and ambient signal pulses, the calculation of Sp02 can be carried out. For example, a maximum of the true Red PPG signal (devoid of ambient noise) can simply be obtained by subtracting the obtained maximum value of the Red PPG signal, obtained when the Red LED is turned on, with the obtained maximum value of the ambient PPG signal, i.e. when none of the LEDs is turned on. Kassim at 22:27-23-3 In other words, instead of reconstructing a true Red PPG signal (devoid of ambient signal) and a true IR PPG signal (devoid of ambient signal), advantageously, reconstruction is avoided in example embodiments, and only the maximum and minimum values of 3 PPG signals are obtained for analysis to obtain Sp02 value. This can minimise processing and consume less power. Kassim at 23:5-9 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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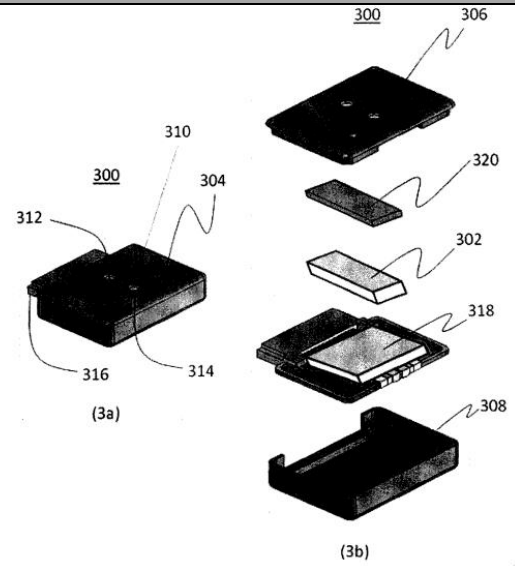
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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Kassim discloses or renders obvious the measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Figure 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Figure 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Figure 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light

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	detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Kassim discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Figure 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 11:34-12:10

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	In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Figure 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Figure 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Figure 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33

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	 Figure 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Kassim discloses or renders obvious measurement system of claim 15, wherein the first arc and the second arc are concentric. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kassim discloses or renders obvious a wearable device for use with a smart phone or tablet. *See* 11[a], 11[k] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	Kassim discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the	Kassim disclose or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelength.

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semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	In some example embodiments, saturation of peripheral oxygen (SP02) information of a user is derivable from detected output light information from both a red LED and an infra-red LED. Further, in the description herein, the term "light" as used herein is meant to be interpreted in a broad sense and is not limited to visible light only. The term "light" as used herein can include, but is not limited to, X-ray light rays, visible light rays, ultraviolet light rays and infra-red light rays. Kassim at 11:23-28 Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Figure 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Figure 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Figure 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Kassim discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue.	Kassim discloses or renders obvious the measurement device further comprising a receiver configured to:capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue. *See* 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Kassim discloses or renders obvious the receiver configured to to synchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Kassim discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Kassim discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[a] , 11[b], 19[a].

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Kassim discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Kassim discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link	Kassim discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Kassim discloses or renders obvious wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 13, 19 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	

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21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Kassim discloses or renders obvious wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Kassim discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claim 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D6

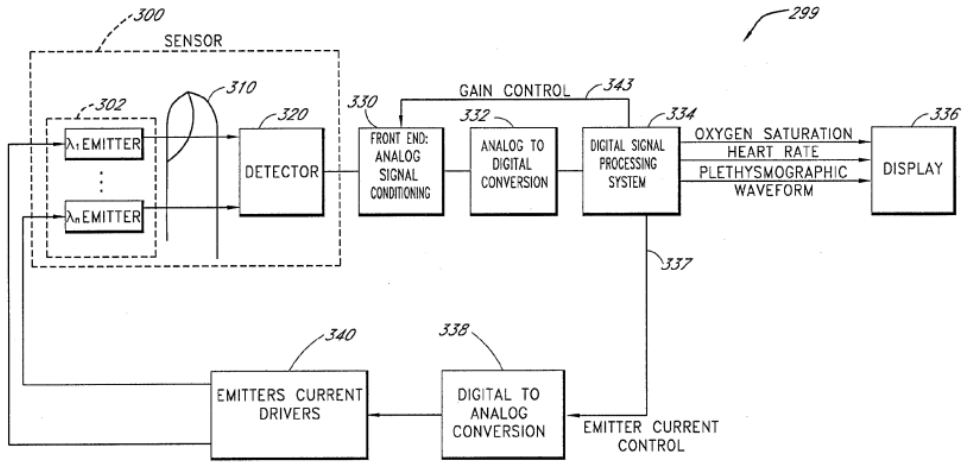
U.S. Pat. No. 10,874,304 in view of U.S. Patent Publication No. 2011/0237911 to Marcelo M. Lamego at el. ("Lamego")

As described in detail below, Lamego (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 B2 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D5 and D7-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. . This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Lamego. The cited portions of Lamego are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Lamego. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Lamego "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Lamego does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Lamego (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Lamego anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 11	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lamego disclose or renders obvious a measurement system.  FIG. 3 Lamego at Fig.3 The present invention relates to the field of signal processing. More specifically, the present invention relates to the processing of measured signals which contain a primary signal portion and a secondary signal portion for the removal or derivation of either signal portion. The present invention is especially useful for physiological monitoring systems, including blood oxygen saturation measurement systems and oximeters. Lamego at [0003] In one embodiment, absorption measurements are based upon the transmission of energy through a medium. In one embodiment, multiple light emitting diodes (LEDs) are positioned on one side of a

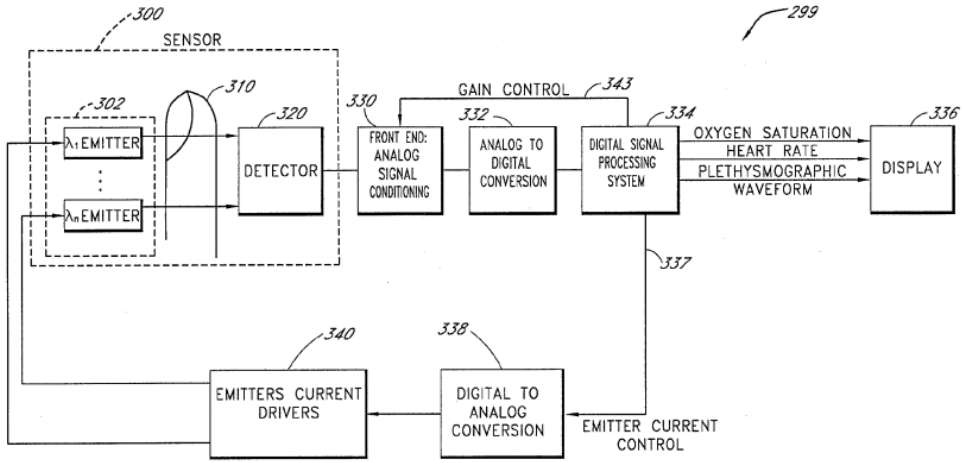
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	portion of the body where blood flows close to the body's surface, such as a finger, and a photodetector is positioned on the opposite side of the surface. In another embodiment one or more such LEDs emit light of different wavelengths. In one embodiment, one LED emits a visible wavelength, such as red, and the other LED emits an infrared wavelength. However, one skilled in the art will realize that other wavelength combinations could be used. Lamego at [0027]. The finger comprises skin, tissue, muscle, both arterial blood and venous blood, fat, etc., each of which absorbs light energy differently due to different absorption coefficients, different concentrations, different thicknesses, and changing optical pathlengths. When the patient is not moving, absorption is substantially constant except for variations due to the flow of blood through the skin, tissue, muscle, etc. A constant attenuation can be determined and subtracted from the measured signal via traditional filtering techniques. However, when the patient moves, perturbations such as changing optical pathlengths occur. Such perturbations may be due to movement of background fluids, (such as venous blood, which has a different saturation than arterial blood). Therefore, the measured signal becomes erratic. Erratic, motion-induced noise typically cannot be predetermined and subtracted from the measured signal via traditional filtering techniques. Thus, determining the oxygen saturation of arterial blood and venous in erratic, motion-induced noise environments, blood becomes more difficult. Lamego at [0028] In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion. Lamego at [0029] In one embodiment, the physiological monitor utilizes a processor to determine a secondary reference signal n′(t) or Nref. The secondary reference signal n′(t) is used to determine the primary portion of the

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	measured signal. In one embodiment, the secondary reference signal n′(t) is input to a multi-variate process estimator, which removes the erratic, motion-induced secondary signal portions from the measured signal. In another embodiment, the processor determines a primary signal reference signal s′(t) which is used for display purposes or for input to a multi-variate process estimator to derive information about patient movement and venous blood oxygen saturation. Lamego at [0030] The ability to measure a physiological parameter with a multi-dimensional system allows the system to compensate and account for the presence of other conditions that may affect the particular physiological parameter being measured. For example, many drugs cause the level of MetHb within a patient's blood to increase. MetHb also absorbs light at the two wavelengths used in a typical two-wavelength physiological monitor, which may cause inaccurate SpO2 readings. Increased levels of MetHb generally cause blood oxygen concentration level (e.g., SpO2) readings to decrease. A two-wavelength physiological monitor would provide reduced readings of blood oxygen concentration, but would not be able to identify the cause for the decreased reading, or to compensate for such readings. On the other hand, a multi-wavelength physiological monitor, such as any of the multi-wavelength physiological monitors described below, could not only identify the cause of decreased SpO2 readings, but also (or alternatively) compensate for such cause when calculating the patient's SpO2 level and/or signal. For example, to compensate for MetHb, one or more wavelengths sensitive to MetHb can be used. The wavelength(s) used can be, for example, about 760 nm and/or about 805 nm or the like. This allows for one or more additional equation (s) and degree(s) of freedom so that solving the system may account for the effect of the level of MetHb on blood oxygen saturation readings. Lamego at [0037] In one embodiment, the multi-wavelength physiological monitor compensates for conditions, such as motion and/or blood constituents that would cause a standard two-wavelength system to over- or under-react to the presence of such condition. Such compensation provides a more accurate, stable reading or a patient's physiological condition, including, but not limited to, their blood oxygen concentration and/or plethysmographic signal. Lamego at [0040]

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	A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Lamego disclose or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths.

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	 ***FIG. 3*** Lamego at Fig. 3. A practical application of this technique is pulse oximetry, which utilizes a noninvasive sensor to measure blood oxygen saturation (SpO2) and pulse rate. A multi-wavelength physiological monitor in accordance with one embodiment determines blood oxygen saturation by propagating multi-wavelength energy through a medium, such as a portion of a patient's body where blood flows close to the body surface. For example, in one embodiment, energy is propagated through an ear lobe, a digit (such as a finger or toe), a forehead, or a scalp (such as a fetus's scalp). An attenuated signal is measured after energy propagation through, or reflection from the medium. The physiological monitor determines the saturation of oxygenated blood in the patient based at least in part upon the measured signal. Lamego at [0024]. In one embodiment, absorption measurements are based upon the transmission of energy through a medium. In one embodiment, multiple light emitting diodes (LEDs) are positioned on one side of a portion of the body where blood flows close to the body's surface, such as a finger, and a photodetector

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	is positioned on the opposite side of the surface. In another embodiment one or more such LEDs emit light of different wavelengths. In one embodiment, one LED emits a visible wavelength, such as red, and the other LED emits an infrared wavelength. However, one skilled in the art will realize that other wavelength combinations could be used. Lamego at [0027] In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion. Lamego at [0029] A multi-wavelength physiological monitor provides additional advantages over a two-wavelength device, as well. For example, utilizing multiple wavelengths provide a multi-dimensional calibration curve, which can be used to provide multiple degrees of freedom to compensate for variation in other physiologically-related parameters. As discussed above, when only two wavelengths are used but there are more than two significant absorbers in the patient's tissue, the system may be underdetermined. Therefore, adding wavelengths sensitive to additional significant absorbers can help the system compensate for the additional significant absorbers and enable more accurate calculation of the concentration of each absorber and the blood oxygen saturation. For example, an eight wavelength physiological monitor utilizes an eight-dimensional calibration curve, which provides eight degrees of freedom to compensate for various physiologically-related parameters. Such parameters can include, for example, noise, motion, various hemodynamic parameters, and/or blood constituent concentrations and/or levels. On the other hand, the system may be overdetermined if, for example, more wavelengths are used than there are significant absorbers and/or wavelengths are used for constituents not present in the particular patient's blood. Lamego at [0035]

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	The ability to measure a physiological parameter with a multi-dimensional system allows the system to compensate and account for the presence of other conditions that may affect the particular physiological parameter being measured. For example, many drugs cause the level of MetHb within a patient's blood to increase. MetHb also absorbs light at the two wavelengths used in a typical two-wavelength physiological monitor, which may cause inaccurate SpO2 readings. Increased levels of MetHb generally cause blood oxygen concentration level (e.g., SpO2) readings to decrease. A two-wavelength physiological monitor would provide reduced readings of blood oxygen concentration, but would not be able to identify the cause for the decreased reading, or to compensate for such readings. On the other hand, a multi-wavelength physiological monitor, such as any of the multi-wavelength physiological monitors described below, could not only identify the cause of decreased SpO2 readings, but also (or alternatively) compensate for such cause when calculating the patient's SpO2 level and/or signal. For example, to compensate for MetHb, one or more wavelengths sensitive to MetHb can be used. The wavelength(s) used can be, for example, about 760 nm and/or about 805 nm or the like. This allows for one or more additional equation (s) and degree(s) of freedom so that solving the system may account for the effect of the level of MetHb on blood oxygen saturation readings. Lamego at [0037] In one embodiment, the multi-wavelength physiological monitor compensates for conditions, such as motion and/or blood constituents that would cause a standard two-wavelength system to over- or under-react to the presence of such condition. Such compensation provides a more accurate, stable reading or a patient's physiological condition, including, but not limited to, their blood oxygen concentration and/or plethysmographic signal. Lamego at [0040] A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is

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	located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] The front end analog signal conditioning circuitry 330 has outputs that are coupled to an analog to digital conversion circuit 332. The analog to digital conversion circuit 332 has outputs that are coupled to a digital signal processing system 334. The digital signal processing system 334 provides desired parameters as outputs for a display 336. Outputs for the display 336 include, for example, blood oxygen saturation, heart rate, and a clean plethysmographic waveform. Lamego at [0042] The signal processing system also provides an emitter current control output 337 to a digital-to-analog converter circuit 338. The digital-to-analog converter circuit 338 provides control information to emitter current drivers 340. The emitter drivers 340 are coupled to the n light emitters 302. The digital signal processing system 334 also provides a gain control output 342 for front end analog signal conditioning circuitry 330. Lamego at [0043] In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a “saturation transform.” It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term “saturation transform” is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean

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	plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048] It should be understood that in different embodiments of the present invention, one or more of the outputs may be provided. The digital signal processing system 334 also provides control for driving the n light emitters 302 with an emitter current control signal on the emitter current control output 337. This value is a digital value which is converted by the digital-to-analog conversion circuit 338, which provides a control signal to the emitter current drivers 340. The emitter current drivers 340 provide the appropriate current drive for the n light emitters 302. Further detail of the operation of the multi-wavelength physiological monitor for pulse oximetry is explained below. Lamego at [0049] In the present embodiment, the n light emitters 302 are driven via the emitter current driver 340 to provide light transmission with digital modulation at 625 Hz. In the present embodiment, the n light emitters 302 are driven at a power level that provides an acceptable intensity for detection by the detector 320 and for conditioning by the front end analog signal conditioning circuitry 330. Once this energy level is determined for a given patient by the digital signal processing system 334, the current level for the n light emitters 302 is maintained substantially constant. It should be understood, however, that the current could be adjusted for changes in the ambient room light and other changes that would affect the voltage input to the front end analog signal conditioning circuitry 330. Lamego at [0050] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320

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	is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0051] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Lamego disclose or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion. Lamego at [0029] In one embodiment, the physiological monitor utilizes a processor to determine a secondary reference signal n′(t) or Nref. The secondary reference signal n′(t) is used to determine the primary portion of the measured signal. In one embodiment, the secondary reference signal n′(t) is input to a multi-variate process estimator, which removes the erratic, motion-induced secondary signal portions from the measured signal. In another embodiment, the processor determines a primary signal reference signal s′(t) which is used for display purposes or for input to a multi-variate process estimator to derive information about patient movement and venous blood oxygen saturation.

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	Lamego at [0030] The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327. The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. Lamego at [0045] In the present embodiment, the output of the voltage to current converters 328 are switched such that, only one emitter is active at any given time. In addition, the voltage to current converter for the inactive emitter is switched off at its input as well, such that it is deactivated. This reduces noise from the switching and voltage to current conversion circuitry. In the present embodiment, low noise voltage to current converters 328 are selected (e.g., Op 27 Op Amps), and the feedback loop is configured to have a low pass filter to reduce noise. In the present embodiment, the low pass filtering function of the voltage to current converters 328 has a corner frequency of just above 625 Hz, which is the switching speed for the emitters 302, as further discussed below. Accordingly, the driver circuit embodiment of FIG. 3A, minimizes the noise of the emitters 302. Lamego at [0047] In the present embodiment, the n light emitters 302 are driven via the emitter current driver 340 to provide light transmission with digital modulation at 625 Hz. In the present embodiment, the n light emitters 302 are driven at a power level that provides an acceptable intensity for detection by the detector 320 and for conditioning by the front end analog signal conditioning circuitry 330. Once this energy level is determined for a given patient by the digital signal processing system 334, the current level for the n light emitters 302 is maintained substantially constant. It should be understood, however, that the current

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	could be adjusted for changes in the ambient room light and other changes that would affect the voltage input to the front end analog signal conditioning circuitry 330. Lamego at [0050] The second analog-to-digital converter 356 accepts the conditioned composite analog signal from the front end signal conditioning circuitry 330 and converts the signal to digital form. In the present embodiment, the second analog to digital converter 356 comprises a single-channel, delta-sigma converter. In the present embodiment, a Crystal Semiconductor CS5317-KS delta-sigma analog to digital converter is used. Such a converter is advantageous in that it is low cost and exhibits low noise characteristics. More specifically, a delta-sigma converter consists of two major portions: a noise modulator and a decimation filter. The selected converter uses a second order analog delta-sigma modulator to provide noise shaping. Noise shaping refers to changing the noise spectrum from a flat response to a response where noise at the lower frequencies has been reduced by increasing noise at higher frequencies. The decimation filter then cuts out the reshaped, higher frequency noise to provide 16-bit performance at a lower frequency. The present converter samples the data 128 times for every 16 bit data word that it produces. In this manner, the converter provides excellent noise rejection, dynamic range and low harmonic distortion, which help in critical measurement situations like low perfusion and electrocautery. Lamego at [0060] In one embodiment, the last several samples from each packet are then processed as follows. A sum of the last four samples from each packet is calculated, as represented in the summing operations 430 of FIG. 7. In the present embodiment, the last four samples are used because a low pass filter in the analog to digital converter 356 of the present embodiment has a settling time. However, any number of samples may be so summed. The selection of the number of samples to be summed will be determined based at least in part on the settling time of the n LEDs 302 (not shown). Collecting the last four samples from each 8-sample packet allows the previous signal to clear. This summing operation provides an integration operation which enhances noise immunity. The sum of the respective ambient light samples is then subtracted from the sum of each of the individual wavelength samples, as represented in the subtraction modules 438. It should be understood that in one embodiment, for n wavelengths of light, there will be n subtraction modules 438. The subtraction operation provides some attenuation of the ambient light signal present in the data. In the present embodiment, it has been found that approximately 20 dB

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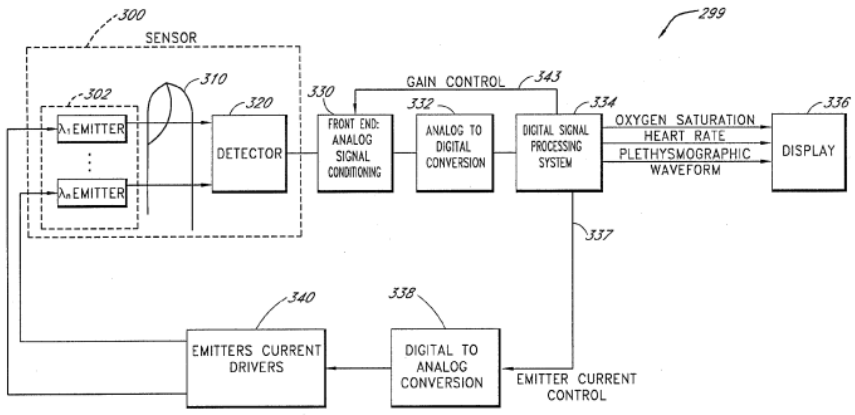
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	attenuation of the ambient light is provided by the operations of the subtraction modules 438. The resultant individual wavelength sum values are divided by the number of samples summed in summing operations 430. In the present embodiment, the sum values are divided by four, as represented in the divide modules 442. Each resultant value provides one sample each of each of the individual wavelengths light signals at 625 Hz. Lamego at [0070] In the present embodiment, the multi-variate process estimator 531 includes a pseudo-inverse, as is known to those of skill in the art. In another embodiment, the multi-variate process estimator 531 is formed by a joint process estimator and a low pass filter. Details of a suitable joint process estimator are provided in U.S. Pat. No. 5,632,272, incorporated by reference herein. However, it will be understood by those of skill in the art that a variety of such processing structures may be utilized. For example, in another embodiment, a correlation canceller, an adaptive linear combiner, an adaptive noise filter (e.g., as shown in FIG. 10A), an adaptive noise canceller, an adaptive linear lattice, a neural network, a radial basis, or a voltera are used individually or in combination, instead of or in addition to the pseudo-inverse embodiment of the multi-variate process estimator 531. Such processing structures are well known to those of skill in the art, and require no further explanation herein. Lamego at [0086] Therefore, in equation (6), β(SaO2)vv is the noise reference signal that can be used in combination with an adaptive linear noise canceller to remove the venous noise signal from the bulk plethysmographic signal. Lamego at [0103]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Lamego disclose or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. In one embodiment, absorption measurements are based upon the transmission of energy through a medium. In one embodiment, multiple light emitting diodes (LEDs) are positioned on one side of a portion of the body where blood flows close to the body's surface, such as a finger, and a photodetector is positioned on the opposite side of the surface. In another embodiment one or more such LEDs emit light of different wavelengths. In one embodiment, one LED emits a visible wavelength, such as red, and the other LED emits an infrared wavelength. However, one skilled in the art will realize that other wavelength combinations could be used. Lamego at [0027] A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths ($\lambda 1, \lambda 2, \ldots \lambda n$). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] FIG. 3A illustrates one embodiment of the drivers 340 and the digital to analog conversion circuit 338. As depicted in FIG. 3A, the digital-to-analog conversion circuit 338 includes first and second input latches 321, 322, a synchronizing latch 323, a voltage reference 324, and a digital to analog conversion circuit 325. The emitter current drivers 340 include first and second switch banks 326, 327, and n voltage to current converters 328. LED emitters 302 of FIG. 3 are coupled to the output of the emitter current drives 340. Lamego at [0044]

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	The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327. The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332 Lamego at [0045]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d]. the wearable measurement device further comprising a receiver configured to:	Lamego disclose or renders obvious the wearable measurement device further comprising a receiver.

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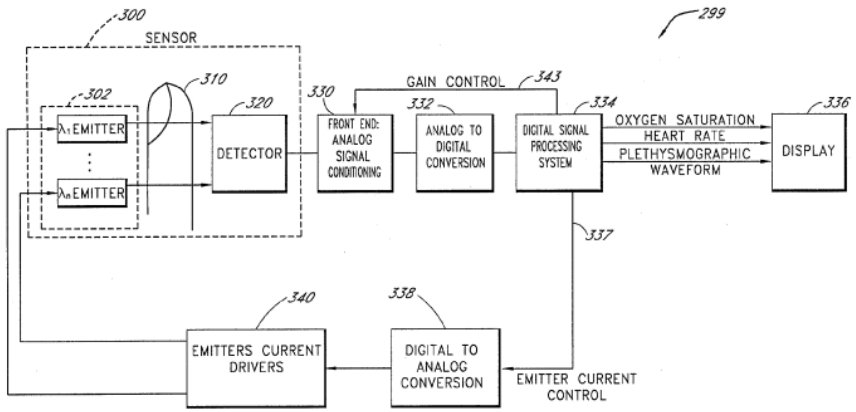
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	 FIG. 3 Lamego at Fig. 3 A physiological monitor for determining blood oxygen saturation of a medical patient includes a sensor, a signal processor and a display. The sensor includes at least three light emitting diodes. Each light emitting diode is adapted to emit light of a different wavelength. The sensor also includes a detector, where the detector is adapted to receive light from the three light emitting diodes after being attenuated by tissue. The detector generates an output signal based at least in part upon the received light. The signal processor determines blood oxygen saturation based at least upon the output signal, and the display provides an indication of the blood oxygen saturation. Lamego at Abstract In one embodiment, absorption measurements are based upon the transmission of energy through a medium. In one embodiment, multiple light emitting diodes (LEDs) are positioned on one side of a portion of the body where blood flows close to the body's surface, such as a finger, and a photodetector is positioned on the opposite side of the surface. In another embodiment one or more such LEDs emit light of different wavelengths. In one embodiment, one LED emits a visible wavelength, such as red, and the other LED emits an infrared wavelength. However, one skilled in the art will realize that other wavelength combinations could be used.

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	Lamego at [0027] A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a “saturation transform.” It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term “saturation transform” is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048]

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	In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0051] The composite time division signal is provided to the front analog signal conditioning circuitry 330. Additional detail regarding the front end analog signal conditioning circuitry 330 and the analog to digital converter circuit 332 is illustrated in FIG. 4. As depicted in FIG. 4, in one embodiment, the front end circuitry 330 has a preamplifier 342, a high pass filter 344, an amplifier 346, a programmable gain amplifier 348, and a low pass filter 350. In one embodiment, the preamplifier 342 is a transimpedance amplifier that converts the composite current signal from the photodetector 320 to a corresponding voltage signal, and amplifies the signal. In the present embodiment, the preamplifier has a predetermined gain to boost the signal amplitude for ease of processing. In the present embodiment, the source voltages for the preamplifier 342 are −15 VDC and +15 VDC. As will be understood, the attenuated signal contains a component representing ambient light as well as a component representing the each of the multi-wavelengths of light over time. If there is light in the vicinity of the sensor 300 other than the multi-wavelengths of light from the n light emitters 302, this ambient light is detected by the photodetector 320. Accordingly, the gain of the preamplifier is selected in order to prevent the ambient light in the signal from saturating the preamplifier under normal and reasonable operating conditions Lamego at [0052] In one embodiment, the first analog-to-digital converter 354 is a diagnostic analog-to-digital converter. The diagnostic task (performed by the digital signal processing system) is to read the output of the detector as amplified by the preamplifier 342 in order to determine if the signal is saturating the input to the high-pass filter 344. In the present embodiment, if the input to the high pass filter 344 becomes

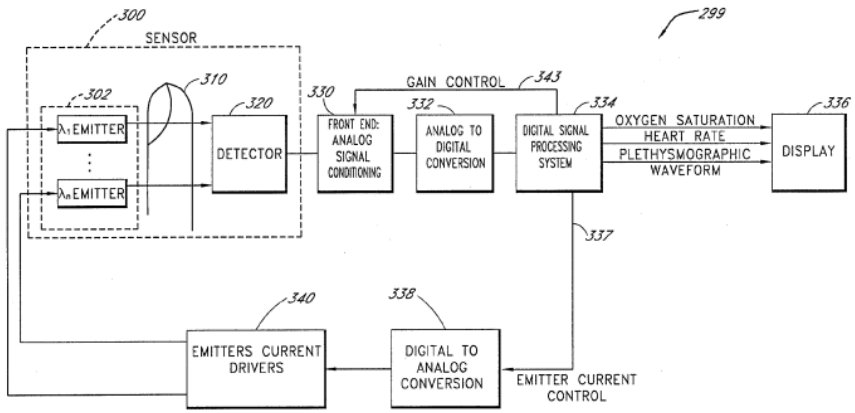
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	saturated, the front end analog signal conditioning circuits 330 provides a “0” output. Alternatively, in another embodiment, a first analog-to-digital converter 354 is not used. Lamego at [0059] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample	Lamego disclose or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample.  ***FIG. 3*** Lamego at Fig. 3. A physiological monitor for determining blood oxygen saturation of a medical patient includes a sensor, a signal processor and a display. The sensor includes at least three light emitting diodes. Each

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	light emitting diode is adapted to emit light of a different wavelength. The sensor also includes a detector, where the detector is adapted to receive light from the three light emitting diodes after being attenuated by tissue. The detector generates an output signal based at least in part upon the received light. The signal processor determines blood oxygen saturation based at least upon the output signal, and the display provides an indication of the blood oxygen saturation. Lamego at Abstract In one embodiment, absorption measurements are based upon the transmission of energy through a medium. In one embodiment, multiple light emitting diodes (LEDs) are positioned on one side of a portion of the body where blood flows close to the body's surface, such as a finger, and a photodetector is positioned on the opposite side of the surface. In another embodiment one or more such LEDs emit light of different wavelengths. In one embodiment, one LED emits a visible wavelength, such as red, and the other LED emits an infrared wavelength. However, one skilled in the art will realize that other wavelength combinations could be used. Lamego at [0027] A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with

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	each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0051] The composite time division signal is provided to the front analog signal conditioning circuitry 330. Additional detail regarding the front end analog signal conditioning circuitry 330 and the analog to digital converter circuit 332 is illustrated in FIG. 4. As depicted in FIG. 4, in one embodiment, the front end circuitry 330 has a preamplifier 342, a high pass filter 344, an amplifier 346, a programmable gain amplifier 348, and a low pass filter 350. In one embodiment, the preamplifier 342 is a transimpedance amplifier that converts the composite current signal from the photodetector 320 to a corresponding voltage signal, and amplifies the signal. In the present embodiment, the preamplifier has a predetermined gain to boost the signal amplitude for ease of processing. In the present embodiment, the source voltages for the preamplifier 342 are −15 VDC and +15 VDC. As will be understood, the attenuated signal contains a component representing ambient light as well as a component representing the each of the multi-wavelengths of light over time. If there is light in the vicinity of the sensor 300 other than the multi-wavelengths of light from the n light emitters 302, this ambient light is detected by the photodetector 320. Accordingly, the gain of the preamplifier is selected in order to prevent the ambient light in the signal from saturating the preamplifier under normal and reasonable operating conditions Lamego at [0052] In one embodiment, the first analog-to-digital converter 354 is a diagnostic analog-to-digital converter. The diagnostic task (performed by the digital signal processing system) is to read the output of the detector as amplified by the preamplifier 342 in order to determine if the signal is saturating the input to the high-pass filter 344. In the present embodiment, if the input to the high pass filter 344 becomes saturated, the front end analog signal conditioning circuits 330 provides a “0” output. Alternatively, in another embodiment, a first analog-to-digital converter 354 is not used. Lamego at [0059]

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Lamego disclose or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample.  FIG. 3 Lamego at Fig. 3. A physiological monitor for determining blood oxygen saturation of a medical patient includes a sensor, a signal processor and a display. The sensor includes at least three light emitting diodes. Each light emitting diode is adapted to emit light of a different wavelength. The sensor also includes a detector, where the detector is adapted to receive light from the three light emitting diodes after being attenuated by tissue. The detector generates an output signal based at least in part upon the received

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	light. The signal processor determines blood oxygen saturation based at least upon the output signal, and the display provides an indication of the blood oxygen saturation. Lamego at Abstract. A practical application of this technique is pulse oximetry, which utilizes a noninvasive sensor to measure blood oxygen saturation (SpO2) and pulse rate. A multi-wavelength physiological monitor in accordance with one embodiment determines blood oxygen saturation by propagating multi-wavelength energy through a medium, such as a portion of a patient's body where blood flows close to the body surface. For example, in one embodiment, energy is propagated through an ear lobe, a digit (such as a finger or toe), a forehead, or a scalp (such as a fetus's scalp). An attenuated signal is measured after energy propagation through, or reflection from the medium. The physiological monitor determines the saturation of oxygenated blood in the patient based at least in part upon the measured signal. Lamego at [0024] In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion. Lamego at [0029] In one embodiment, the physiological monitor utilizes a processor to determine a secondary reference signal n′(t) or Nref. The secondary reference signal n′(t) is used to determine the primary portion of the measured signal. In one embodiment, the secondary reference signal n′(t) is input to a multi-variate process estimator, which removes the erratic, motion-induced secondary signal portions from the measured signal. In another embodiment, the processor determines a primary signal reference signal s′(t) which is used for display purposes or for input to a multi-variate process estimator to derive information about patient movement and venous blood oxygen saturation.

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	Lamego at [0030] Furthermore, traditional physiological monitors that utilize two light sources to derive a patient's plethysmographic signal generally require one light source's wavelength to fall in the red spectrum and the other light source's wavelength to fall in the infrared spectrum. However, a multi-wavelength physiological monitor advantageously provides the ability to utilize all infrared wavelength light sources and/or other non-red infrared light sources to derive an accurate plethysmographic waveform. One advantage of utilizing non-red wavelength light sources (for example, all infrared wavelength light sources) is that the multi-wavelength physiological monitor can be further configured to determine several blood constituent concentrations based upon signals measured from just the non-red light sources. For example, such a multi-wavelength physiological monitor can determine levels and/or concentrations of: methemoglobin (MetHb), carboxyhemoglobin (COHb), low hemoglobin levels, high hemoglobin levels, bilirubin, methylene blue, deoxyhemoglobin, and lipids. Lamego at [0036] The ability to measure a physiological parameter with a multi-dimensional system allows the system to compensate and account for the presence of other conditions that may affect the particular physiological parameter being measured. For example, many drugs cause the level of MetHb within a patient's blood to increase. MetHb also absorbs light at the two wavelengths used in a typical two-wavelength physiological monitor, which may cause inaccurate SpO2 readings. Increased levels of MetHb generally cause blood oxygen concentration level (e.g., SpO2) readings to decrease. A two-wavelength physiological monitor would provide reduced readings of blood oxygen concentration, but would not be able to identify the cause for the decreased reading, or to compensate for such readings. On the other hand, a multi-wavelength physiological monitor, such as any of the multi-wavelength physiological monitors described below, could not only identify the cause of decreased SpO2 readings, but also (or alternatively) compensate for such cause when calculating the patient's SpO2 level and/or signal. For example, to compensate for MetHb, one or more wavelengths sensitive to MetHb can be used. The wavelength(s) used can be, for example, about 760 nm and/or about 805 nm or the like. This allows for one or more additional equation (s) and degree(s) of freedom so that solving the system may account for the effect of the level of MetHb on blood oxygen saturation readings. Lamego at [0037]

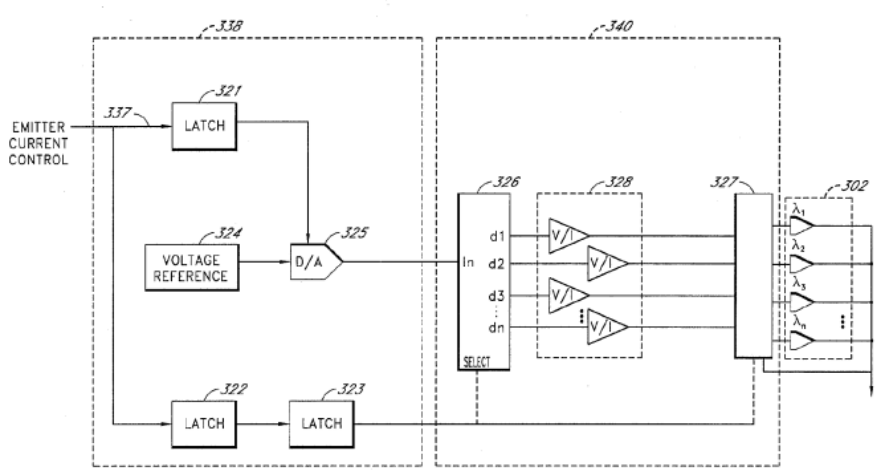
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	In one embodiment, the multi-wavelength physiological monitor compensates for conditions, such as motion and/or blood constituents that would cause a standard two-wavelength system to over- or under-react to the presence of such condition. Such compensation provides a more accurate, stable reading or a patient's physiological condition, including, but not limited to, their blood oxygen concentration and/or plethysmographic signal. Lamego at [0040] A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] The front end analog signal conditioning circuitry 330 has outputs that are coupled to an analog to digital conversion circuit 332. The analog to digital conversion circuit 332 has outputs that are coupled to a digital signal processing system 334. The digital signal processing system 334 provides desired parameters as outputs for a display 336. Outputs for the display 336 include, for example, blood oxygen saturation, heart rate, and a clean plethysmographic waveform. Lamego at [0042] The signal processing system also provides an emitter current control output 337 to a digital-to-analog converter circuit 338. The digital-to-analog converter circuit 338 provides control information to emitter current drivers 340. The emitter drivers 340 are coupled to the n light emitters 302. The digital signal

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	processing system 334 also provides a gain control output 342 for front end analog signal conditioning circuitry 330. Lamego at [0043] In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a “saturation transform.” It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term “saturation transform” is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048] It should be understood that in different embodiments of the present invention, one or more of the outputs may be provided. The digital signal processing system 334 also provides control for driving the n light emitters 302 with an emitter current control signal on the emitter current control output 337. This value is a digital value which is converted by the digital-to-analog conversion circuit 338, which provides a control signal to the emitter current drivers 340. The emitter current drivers 340 provide the appropriate current drive for the n light emitters 302. Further detail of the operation of the multi-wavelength physiological monitor for pulse oximetry is explained below. Lamego at [0049]

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	In the present embodiment, the n light emitters 302 are driven via the emitter current driver 340 to provide light transmission with digital modulation at 625 Hz. In the present embodiment, the n light emitters 302 are driven at a power level that provides an acceptable intensity for detection by the detector 320 and for conditioning by the front end analog signal conditioning circuitry 330. Once this energy level is determined for a given patient by the digital signal processing system 334, the current level for the n light emitters 302 is maintained substantially constant. It should be understood, however, that the current could be adjusted for changes in the ambient room light and other changes that would affect the voltage input to the front end analog signal conditioning circuitry 330. Lamego at [0050] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0051] The composite time division signal is provided to the front analog signal conditioning circuitry 330. Additional detail regarding the front end analog signal conditioning circuitry 330 and the analog to digital converter circuit 332 is illustrated in FIG. 4. As depicted in FIG. 4, in one embodiment, the front end circuitry 330 has a preamplifier 342, a high pass filter 344, an amplifier 346, a programmable gain amplifier 348, and a low pass filter 350. In one embodiment, the preamplifier 342 is a transimpedance amplifier that converts the composite current signal from the photodetector 320 to a corresponding voltage signal, and amplifies the signal. In the present embodiment, the preamplifier has a predetermined gain to boost the signal amplitude for ease of processing. In the present embodiment, the source voltages for the preamplifier 342 are −15 VDC and +15 VDC. As will be understood, the attenuated signal contains a component representing ambient light as well as a component representing the each of the multi-wavelengths of light over time. If there is light in the vicinity of the sensor 300 other than the

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	multi-wavelengths of light from the n light emitters 302, this ambient light is detected by the photodetector 320. Accordingly, the gain of the preamplifier is selected in order to prevent the ambient light in the signal from saturating the preamplifier under normal and reasonable operating conditions. Lamego at [0052]. The output of the amplifier 346 provides an input to a programmable gain amplifier 348. The programmable gain amplifier 348 also accepts a programming input from the digital signal processing system 334 on a gain control signal line 343. In one embodiment, the gain of the programmable gain amplifier 348 is digitally programmable. The gain is adjusted dynamically at initialization or at sensor placement due to changes in the medium (e.g., the finger) and due to variations in the medium from patient to patient. Therefore, a dynamically adjustable amplifier is provided by the programmable gain amplifier 348 in order to obtain a signal suitable for processing. Lamego at [0055] In one embodiment, the first analog-to-digital converter 354 is a diagnostic analog-to-digital converter. The diagnostic task (performed by the digital signal processing system) is to read the output of the detector as amplified by the preamplifier 342 in order to determine if the signal is saturating the input to the high-pass filter 344. In the present embodiment, if the input to the high pass filter 344 becomes saturated, the front end analog signal conditioning circuits 330 provides a “0” output. Alternatively, in another embodiment, a first analog-to-digital converter 354 is not used. Lamego at [0059] The second analog-to-digital converter 356 accepts the conditioned composite analog signal from the front end signal conditioning circuitry 330 and converts the signal to digital form. In the present embodiment, the second analog to digital converter 356 comprises a single-channel, delta-sigma converter. In the present embodiment, a Crystal Semiconductor CS5317-KS delta-sigma analog to digital converter is used. Such a converter is advantageous in that it is low cost and exhibits low noise characteristics. More specifically, a delta-sigma converter consists of two major portions: a noise modulator and a decimation filter. The selected converter uses a second order analog delta-sigma modulator to provide noise shaping. Noise shaping refers to changing the noise spectrum from a flat response to a response where noise at the lower frequencies has been reduced by increasing noise at

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	higher frequencies. The decimation filter then cuts out the reshaped, higher frequency noise to provide 16-bit performance at a lower frequency. The present converter samples the data 128 times for every 16 bit data word that it produces. In this manner, the converter provides excellent noise rejection, dynamic range and low harmonic distortion, which help in critical measurement situations like low perfusion and electrocautery. Lamego at [0060]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	Lamego disclose or renders obvious the receiver configured to synchronize to the light source.  FIG. 3A Lamego at Fig. 3a.

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	A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] The front end analog signal conditioning circuitry 330 has outputs that are coupled to an analog to digital conversion circuit 332. The analog to digital conversion circuit 332 has outputs that are coupled to a digital signal processing system 334. The digital signal processing system 334 provides desired parameters as outputs for a display 336. Outputs for the display 336 include, for example, blood oxygen saturation, heart rate, and a clean plethysmographic waveform. Lamego at [0042] FIG. 3A illustrates one embodiment of the drivers 340 and the digital to analog conversion circuit 338. As depicted in FIG. 3A, the digital-to-analog conversion circuit 338 includes first and second input latches 321, 322, a synchronizing latch 323, a voltage reference 324, and a digital to analog conversion circuit 325. The emitter current drivers 340 include first and second switch banks 326, 327, and n voltage to current converters 328. LED emitters 302 of FIG. 3 are coupled to the output of the emitter current drives 340. Lamego at [0044] The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes

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	the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327. The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. Lamego at [0045] In the present embodiment, the n light emitters 302 are driven via the emitter current driver 340 to provide light transmission with digital modulation at 625 Hz. In the present embodiment, the n light emitters 302 are driven at a power level that provides an acceptable intensity for detection by the detector 320 and for conditioning by the front end analog signal conditioning circuitry 330. Once this energy level is determined for a given patient by the digital signal processing system 334, the current level for the n light emitters 302 is maintained substantially constant. It should be understood, however, that the current could be adjusted for changes in the ambient room light and other changes that would affect the voltage input to the front end analog signal conditioning circuitry 330. Lamego at [0050] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0051] Because the signal processing system 334 controls the activation of the light emitters 302, the entire system is synchronous. In one embodiment, the data is synchronously divided (and thereby demodulated)

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	into 2n 8-sample packets, with a time division demultiplexing operation as represented in a demultiplexing module 421. One eight-sample packet 422 represents the first wavelength of light plus ambient light signal, a second eight-sample packet 424 represents an ambient light signal, a third eight-sample packet (not shown) represents the attenuated second wavelength of light plus ambient light signal, a fourth eight-sample packet (not shown) represents the ambient light signal. This structure repeats until the (2n−1)th eight-sample packet 426, which represents the attenuated nth wavelength of light plus ambient light signal, and 2nth eight-sample packet 428, which represents an ambient light signal. A select signal synchronously controls the demultiplexing operation so as to divide the time-division multiplexed composite signal at the input of the demultiplexer 421 into its n subparts. Lamego at [0069] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the captured light into a first signal,	Lamego disclose or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal. The finger comprises skin, tissue, muscle, both arterial blood and venous blood, fat, etc., each of which absorbs light energy differently due to different absorption coefficients, different concentrations, different thicknesses, and changing optical pathlengths. When the patient is not moving, absorption is substantially constant except for variations due to the flow of blood through the skin, tissue, muscle, etc. A constant attenuation can be determined and subtracted from the measured signal via traditional filtering techniques. However, when the patient moves, perturbations such as changing optical pathlengths occur. Such perturbations may be due to movement of background fluids, (such as venous blood, which has a different saturation than arterial blood). Therefore, the measured signal becomes erratic. Erratic, motion-induced noise typically cannot be predetermined and subtracted from the measured signal via traditional filtering techniques. Thus, determining the oxygen saturation of arterial blood and venous in erratic, motion-induced noise environments, blood becomes more difficult.

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	Lamego at [0028] In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion. Lamego at [0029] In one embodiment, the physiological monitor utilizes a processor to determine a secondary reference signal n′(t) or Nref. The secondary reference signal n′(t) is used to determine the primary portion of the measured signal. In one embodiment, the secondary reference signal n′(t) is input to a multi-variate process estimator, which removes the erratic, motion-induced secondary signal portions from the measured signal. In another embodiment, the processor determines a primary signal reference signal s′(t) which is used for display purposes or for input to a multi-variate process estimator to derive information about patient movement and venous blood oxygen saturation. Lamego at [0030] In the present embodiment, the output of the voltage to current converters 328 are switched such that, only one emitter is active at any given time. In addition, the voltage to current converter for the inactive emitter is switched off at its input as well, such that it is deactivated. This reduces noise from the switching and voltage to current conversion circuitry. In the present embodiment, low noise voltage to current converters 328 are selected (e.g., Op 27 Op Amps), and the feedback loop is configured to have a low pass filter to reduce noise. In the present embodiment, the low pass filtering function of the voltage to current converters 328 has a corner frequency of just above 625 Hz, which is the switching speed for the emitters 302, as further discussed below. Accordingly, the driver circuit embodiment of FIG. 3A, minimizes the noise of the emitters 302. Lamego at [0047]

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	In one embodiment, the last several samples from each packet are then processed as follows. A sum of the last four samples from each packet is calculated, as represented in the summing operations 430 of FIG. 7. In the present embodiment, the last four samples are used because a low pass filter in the analog to digital converter 356 of the present embodiment has a settling time. However, any number of samples may be so summed. The selection of the number of samples to be summed will be determined based at least in part on the settling time of the n LEDs 302 (not shown). Collecting the last four samples from each 8-sample packet allows the previous signal to clear. This summing operation provides an integration operation which enhances noise immunity. The sum of the respective ambient light samples is then subtracted from the sum of each of the individual wavelength samples, as represented in the subtraction modules 438. It should be understood that in one embodiment, for n wavelengths of light, there will be n subtraction modules 438. The subtraction operation provides some attenuation of the ambient light signal present in the data. In the present embodiment, it has been found that approximately 20 dB attenuation of the ambient light is provided by the operations of the subtraction modules 438. The resultant individual wavelength sum values are divided by the number of samples summed in summing operations 430. In the present embodiment, the sum values are divided by four, as represented in the divide modules 442. Each resultant value provides one sample each of each of the individual wavelengths light signals at 625 Hz. Lamego at [0070] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a	Lamego disclose or renders obvious to the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. A physiological monitor for determining blood oxygen saturation of a medical patient includes a sensor, a signal processor and a display. The sensor includes at least three light emitting diodes. Each light

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portion of the analysis output beam reflected or transmitted from the sample,	emitting diode is adapted to emit light of a different wavelength. The sensor also includes a detector, where the detector is adapted to receive light from the three light emitting diodes after being attenuated by tissue. The detector generates an output signal based at least in part upon the received light. The signal processor determines blood oxygen saturation based at least upon the output signal, and the display provides an indication of the blood oxygen saturation. Lamego at Abstract. In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion. Lamego at [0029] Furthermore, traditional physiological monitors that utilize two light sources to derive a patient's plethysmographic signal generally require one light source's wavelength to fall in the red spectrum and the other light source's wavelength to fall in the infrared spectrum. However, a multi-wavelength physiological monitor advantageously provides the ability to utilize all infrared wavelength light sources and/or other non-red infrared light sources to derive an accurate plethysmographic waveform. One advantage of utilizing non-red wavelength light sources (for example, all infrared wavelength light sources) is that the multi-wavelength physiological monitor can be further configured to determine several blood constituent concentrations based upon signals measured from just the non-red light sources. For example, such a multi-wavelength physiological monitor can determine levels and/or concentrations of: methemoglobin (MetHb), carboxyhemoglobin (COHb), low hemoglobin levels, high hemoglobin levels, bilirubin, methylene blue, deoxyhemoglobin, and lipids. Lamego at [0036] A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse

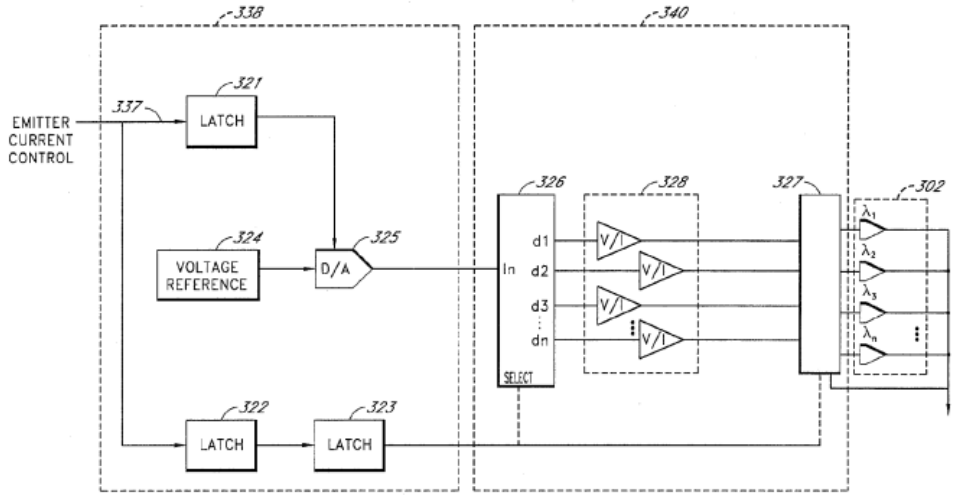
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	oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] The front end analog signal conditioning circuitry 330 has outputs that are coupled to an analog to digital conversion circuit 332. The analog to digital conversion circuit 332 has outputs that are coupled to a digital signal processing system 334. The digital signal processing system 334 provides desired parameters as outputs for a display 336. Outputs for the display 336 include, for example, blood oxygen saturation, heart rate, and a clean plethysmographic waveform. Lamego at [0042] The signal processing system also provides an emitter current control output 337 to a digital-to-analog converter circuit 338. The digital-to-analog converter circuit 338 provides control information to emitter current drivers 340. The emitter drivers 340 are coupled to the n light emitters 302. The digital signal processing system 334 also provides a gain control output 342 for front end analog signal conditioning circuitry 330. Lamego at [0043] In the present embodiment, the output of the voltage to current converters 328 are switched such that, only one emitter is active at any given time. In addition, the voltage to current converter for the inactive emitter is switched off at its input as well, such that it is deactivated. This reduces noise from the switching and voltage to current conversion circuitry. In the present embodiment, low noise voltage to current converters 328 are selected (e.g., Op 27 Op Amps), and the feedback loop is configured to have a low pass filter to reduce noise. In the present embodiment, the low pass filtering function of the voltage to current converters 328 has a corner frequency of just above 625 Hz, which is the switching speed for

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	the emitters 302, as further discussed below. Accordingly, the driver circuit embodiment of FIG. 3A, minimizes the noise of the emitters 302. Lamego at [0047] In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a "saturation transform." It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term "saturation transform" is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048] The composite time division signal is provided to the front analog signal conditioning circuitry 330. Additional detail regarding the front end analog signal conditioning circuitry 330 and the analog to digital converter circuit 332 is illustrated in FIG. 4. As depicted in FIG. 4, in one embodiment, the front end circuitry 330 has a preamplifier 342, a high pass filter 344, an amplifier 346, a programmable gain amplifier 348, and a low pass filter 350. In one embodiment, the preamplifier 342 is a transimpedance amplifier that converts the composite current signal from the photodetector 320 to a corresponding voltage signal, and amplifies the signal. In the present embodiment, the preamplifier has a predetermined gain to boost the signal amplitude for ease of processing. In the present embodiment, the source voltages for the preamplifier 342 are −15 VDC and +15 VDC. As will be understood, the attenuated signal contains a component representing ambient light as well as a component representing the each of the multi-wavelengths of light over time. If there is light in the vicinity of the sensor 300 other than the

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	multi-wavelengths of light from the n light emitters 302, this ambient light is detected by the photodetector 320. Accordingly, the gain of the preamplifier is selected in order to prevent the ambient light in the signal from saturating the preamplifier under normal and reasonable operating conditions. Lamego at [0052] The output of the amplifier 346 provides an input to a programmable gain amplifier 348. The programmable gain amplifier 348 also accepts a programming input from the digital signal processing system 334 on a gain control signal line 343. In one embodiment, the gain of the programmable gain amplifier 348 is digitally programmable. The gain is adjusted dynamically at initialization or at sensor placement due to changes in the medium (e.g., the finger) and due to variations in the medium from patient to patient. Therefore, a dynamically adjustable amplifier is provided by the programmable gain amplifier 348 in order to obtain a signal suitable for processing. Lamego at [0055] The second analog-to-digital converter 356 accepts the conditioned composite analog signal from the front end signal conditioning circuitry 330 and converts the signal to digital form. In the present embodiment, the second analog to digital converter 356 comprises a single-channel, delta-sigma converter. In the present embodiment, a Crystal Semiconductor CS5317-KS delta-sigma analog to digital converter is used. Such a converter is advantageous in that it is low cost and exhibits low noise characteristics. More specifically, a delta-sigma converter consists of two major portions: a noise modulator and a decimation filter. The selected converter uses a second order analog delta-sigma modulator to provide noise shaping. Noise shaping refers to changing the noise spectrum from a flat response to a response where noise at the lower frequencies has been reduced by increasing noise at higher frequencies. The decimation filter then cuts out the reshaped, higher frequency noise to provide 16-bit performance at a lower frequency. The present converter samples the data 128 times for every 16 bit data word that it produces. In this manner, the converter provides excellent noise rejection, dynamic range and low harmonic distortion, which help in critical measurement situations like low perfusion and electrocautery. Lamego at [0060]

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	In one embodiment, the last several samples from each packet are then processed as follows. A sum of the last four samples from each packet is calculated, as represented in the summing operations 430 of FIG. 7. In the present embodiment, the last four samples are used because a low pass filter in the analog to digital converter 356 of the present embodiment has a settling time. However, any number of samples may be so summed. The selection of the number of samples to be summed will be determined based at least in part on the settling time of the n LEDs 302 (not shown). Collecting the last four samples from each 8-sample packet allows the previous signal to clear. This summing operation provides an integration operation which enhances noise immunity. The sum of the respective ambient light samples is then subtracted from the sum of each of the individual wavelength samples, as represented in the subtraction modules 438. It should be understood that in one embodiment, for n wavelengths of light, there will be n subtraction modules 438. The subtraction operation provides some attenuation of the ambient light signal present in the data. In the present embodiment, it has been found that approximately 20 dB attenuation of the ambient light is provided by the operations of the subtraction modules 438. The resultant individual wavelength sum values are divided by the number of samples summed in summing operations 430. In the present embodiment, the sum values are divided by four, as represented in the divide modules 442. Each resultant value provides one sample each of each of the individual wavelengths light signals at 625 Hz. Lamego at [0070] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Lamego disclose or renders obvious the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal.

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	 ***FIG. 3A*** Lamego at Fig. 3a The finger comprises skin, tissue, muscle, both arterial blood and venous blood, fat, etc., each of which absorbs light energy differently due to different absorption coefficients, different concentrations, different thicknesses, and changing optical pathlengths. When the patient is not moving, absorption is substantially constant except for variations due to the flow of blood through the skin, tissue, muscle, etc. A constant attenuation can be determined and subtracted from the measured signal via traditional filtering techniques. However, when the patient moves, perturbations such as changing optical pathlengths occur. Such perturbations may be due to movement of background fluids, (such as venous blood, which has a different saturation than arterial blood). Therefore, the measured signal becomes erratic. Erratic, motion-induced noise typically cannot be predetermined and subtracted from the measured signal via traditional filtering techniques. Thus, determining the oxygen saturation of arterial blood and venous in erratic, motion-induced noise environments, blood becomes more difficult. Lamego at [0028]

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	In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion. Lamego at [0029] In one embodiment, the physiological monitor utilizes a processor to determine a secondary reference signal n′(t) or Nref. The secondary reference signal n′(t) is used to determine the primary portion of the measured signal. In one embodiment, the secondary reference signal n′(t) is input to a multi-variate process estimator, which removes the erratic, motion-induced secondary signal portions from the measured signal. In another embodiment, the processor determines a primary signal reference signal s′(t) which is used for display purposes or for input to a multi-variate process estimator to derive information about patient movement and venous blood oxygen saturation. Lamego at [0030] The curve 120 contains lower and upper limit range curves 122, 124. However, the lower and upper limit range curves 122, 124 of the multi-wavelength physiological monitor are more linear than the lower and upper range curves 104, 106 of the dual-wavelength blood oximeter described above, as illustrated in FIG. 1. In addition, the lower and upper limit range curves 122, 124 of the multi-wavelength physiological monitor exhibit higher accuracy and lower tolerance 126 than the dual-wavelength blood oximeter of FIG. 1, particularly at lower arterial blood oxygen saturation levels. In certain cases, such as during the monitoring of neonates, or persons with low blood-oxygen saturation, it is desirable for the physiological monitor to exhibit increased accuracy at lower saturation levels. For example, when providing oxygen to a neonate, it is often critical that neither too much oxygen nor too little oxygen is provided. A multi-wavelength physiological monitor provides improved accuracy as well as an improved signal-to-noise ratio at lower perfusion levels. Lamego at [0034]

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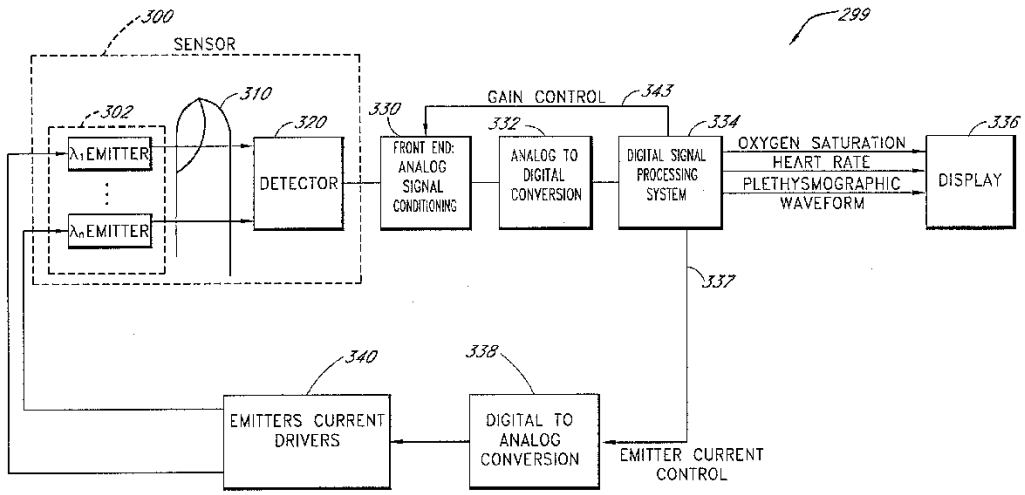
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	A multi-wavelength physiological monitor provides additional advantages over a two-wavelength device, as well. For example, utilizing multiple wavelengths provide a multi-dimensional calibration curve, which can be used to provide multiple degrees of freedom to compensate for variation in other physiologically-related parameters. As discussed above, when only two wavelengths are used but there are more than two significant absorbers in the patient's tissue, the system may be underdetermined. Therefore, adding wavelengths sensitive to additional significant absorbers can help the system compensate for the additional significant absorbers and enable more accurate calculation of the concentration of each absorber and the blood oxygen saturation. For example, an eight wavelength physiological monitor utilizes an eight-dimensional calibration curve, which provides eight degrees of freedom to compensate for various physiologically-related parameters. Such parameters can include, for example, noise, motion, various hemodynamic parameters, and/or blood constituent concentrations and/or levels. On the other hand, the system may be overdetermined if, for example, more wavelengths are used than there are significant absorbers and/or wavelengths are used for constituents not present in the particular patient's blood. Lamego at [0035] The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327. The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. Lamego at [0045] In the present embodiment, the output of the voltage to current converters 328 are switched such that, only one emitter is active at any given time. In addition, the voltage to current converter for the inactive emitter is switched off at its input as well, such that it is deactivated. This reduces noise from the switching and voltage to current conversion circuitry. In the present embodiment, low noise voltage to

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	current converters 328 are selected (e.g., Op 27 Op Amps), and the feedback loop is configured to have a low pass filter to reduce noise. In the present embodiment, the low pass filtering function of the voltage to current converters 328 has a corner frequency of just above 625 Hz, which is the switching speed for the emitters 302, as further discussed below. Accordingly, the driver circuit embodiment of FIG. 3A, minimizes the noise of the emitters 302. Lamego at [0047] The second analog-to-digital converter 356 accepts the conditioned composite analog signal from the front end signal conditioning circuitry 330 and converts the signal to digital form. In the present embodiment, the second analog to digital converter 356 comprises a single-channel, delta-sigma converter. In the present embodiment, a Crystal Semiconductor CS5317-KS delta-sigma analog to digital converter is used. Such a converter is advantageous in that it is low cost and exhibits low noise characteristics. More specifically, a delta-sigma converter consists of two major portions: a noise modulator and a decimation filter. The selected converter uses a second order analog delta-sigma modulator to provide noise shaping. Noise shaping refers to changing the noise spectrum from a flat response to a response where noise at the lower frequencies has been reduced by increasing noise at higher frequencies. The decimation filter then cuts out the reshaped, higher frequency noise to provide 16-bit performance at a lower frequency. The present converter samples the data 128 times for every 16 bit data word that it produces. In this manner, the converter provides excellent noise rejection, dynamic range and low harmonic distortion, which help in critical measurement situations like low perfusion and electrocautery. Lamego at [0060] In one embodiment, the last several samples from each packet are then processed as follows. A sum of the last four samples from each packet is calculated, as represented in the summing operations 430 of FIG. 7. In the present embodiment, the last four samples are used because a low pass filter in the analog to digital converter 356 of the present embodiment has a settling time. However, any number of samples may be so summed. The selection of the number of samples to be summed will be determined based at least in part on the settling time of the n LEDs 302 (not shown). Collecting the last four samples from each 8-sample packet allows the previous signal to clear. This summing operation provides an integration operation which enhances noise immunity. The sum of the respective ambient light samples is then subtracted from the sum of each of the individual wavelength samples, as represented in the subtraction

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	modules 438. It should be understood that in one embodiment, for n wavelengths of light, there will be n subtraction modules 438. The subtraction operation provides some attenuation of the ambient light signal present in the data. In the present embodiment, it has been found that approximately 20 dB attenuation of the ambient light is provided by the operations of the subtraction modules 438. The resultant individual wavelength sum values are divided by the number of samples summed in summing operations 430. In the present embodiment, the sum values are divided by four, as represented in the divide modules 442. Each resultant value provides one sample each of each of the individual wavelengths light signals at 625 Hz. Lamego at [0070] In the present embodiment, the multi-variate process estimator 531 includes a pseudo-inverse, as is known to those of skill in the art. In another embodiment, the multi-variate process estimator 531 is formed by a joint process estimator and a low pass filter. Details of a suitable joint process estimator are provided in U.S. Pat. No. 5,632,272, incorporated by reference herein. However, it will be understood by those of skill in the art that a variety of such processing structures may be utilized. For example, in another embodiment, a correlation canceller, an adaptive linear combiner, an adaptive noise filter (e.g., as shown in FIG. 10A), an adaptive noise canceller, an adaptive linear lattice, a neural network, a radial basis, or a voltera are used individually or in combination, instead of or in addition to the pseudo-inverse embodiment of the multi-variate process estimator 531. Such processing structures are well known to those of skill in the art, and require no further explanation herein. Lamego at [0086] Therefore, in equation (6), β(SaO2)vv is the noise reference signal that can be used in combination with an adaptive linear noise canceller to remove the venous noise signal from the bulk plethysmographic signal. Lamego at [0103] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	Lamego discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link.  **FIG. 3** Lamego at Fig. 3 The front end analog signal conditioning circuitry 330 has outputs that are coupled to an analog to digital conversion circuit 332. The analog to digital conversion circuit 332 has outputs that are coupled to a digital signal processing system 334. The digital signal processing system 334 provides desired

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	parameters as outputs for a display 336. Outputs for the display 336 include, for example, blood oxygen saturation, heart rate, and a clean plethysmographic waveform. Lamego at [0042] In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a “saturation transform.” It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term “saturation transform” is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048] If the correlation is too low, the bin is discarded. If the saturation value of the selected peak for a given bin is lower than the seed saturation for the same bin, the peak is replaced with the seed saturation value. If any wavelength's RMS value is below a threshold, the bins are all discarded, and no saturation value is provided, because the measured signals are considered to be too small to obtain meaningful data. If no bins contain acceptable data, the exception handling module 563 provides a message to the display 336 that the data is erroneous. Lamego at [0117] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Lamego discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lamego discloses or renders obvious wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. In the present embodiment, the multi-variate process estimator 531 includes a pseudo-inverse, as is known to those of skill in the art. In another embodiment, the multi-variate process estimator 531 is formed by a joint process estimator and a low pass filter. Details of a suitable joint process estimator are provided in U.S. Pat. No. 5,632,272, incorporated by reference herein. However, it will be understood by those of skill in the art that a variety of such processing structures may be utilized. For example, in another embodiment, a correlation canceller, an adaptive linear combiner, an adaptive noise filter (e.g., as shown in FIG. 10A), an adaptive noise canceller, an adaptive linear lattice, a neural network, a radial basis, or a voltera are used individually or in combination, instead of or in addition to the pseudo-inverse

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	embodiment of the multi-variate process estimator 531. Such processing structures are well known to those of skill in the art, and require no further explanation herein. Lamego at [0086] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a]. wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Lamego discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. In one embodiment, the physiological monitor utilizes a processor to determine a secondary reference signal n′(t) or Nref. The secondary reference signal n′(t) is used to determine the primary portion of the measured signal. In one embodiment, the secondary reference signal n′(t) is input to a multi-variate process estimator, which removes the erratic, motion-induced secondary signal portions from the measured signal. In another embodiment, the processor determines a primary signal reference signal s′(t) which is used for display purposes or for input to a multi-variate process estimator to derive information about patient movement and venous blood oxygen saturation. Lamego at [0030] The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327.

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	The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. Lamego at [0045] In the present embodiment, the output of the voltage to current converters 328 are switched such that, only one emitter is active at any given time. In addition, the voltage to current converter for the inactive emitter is switched off at its input as well, such that it is deactivated. This reduces noise from the switching and voltage to current conversion circuitry. In the present embodiment, low noise voltage to current converters 328 are selected (e.g., Op 27 Op Amps), and the feedback loop is configured to have a low pass filter to reduce noise. In the present embodiment, the low pass filtering function of the voltage to current converters 328 has a corner frequency of just above 625 Hz, which is the switching speed for the emitters 302, as further discussed below. Accordingly, the driver circuit embodiment of FIG. 3A, minimizes the noise of the emitters 302. Lamego at [0047] In the present embodiment, the multi-variate process estimator 531 includes a pseudo-inverse, as is known to those of skill in the art. In another embodiment, the multi-variate process estimator 531 is formed by a joint process estimator and a low pass filter. Details of a suitable joint process estimator are provided in U.S. Pat. No. 5,632,272, incorporated by reference herein. However, it will be understood by those of skill in the art that a variety of such processing structures may be utilized. For example, in another embodiment, a correlation canceller, an adaptive linear combiner, an adaptive noise filter (e.g., as shown in FIG. 10A), an adaptive noise canceller, an adaptive linear lattice, a neural network, a radial basis, or a voltera are used individually or in combination, instead of or in addition to the pseudo-inverse embodiment of the multi-variate process estimator 531. Such processing structures are well known to those of skill in the art, and require no further explanation herein. Lamego at [0086] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Lamego discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. The finger comprises skin, tissue, muscle, both arterial blood and venous blood, fat, etc., each of which absorbs light energy differently due to different absorption coefficients, different concentrations, different thicknesses, and changing optical pathlengths. When the patient is not moving, absorption is substantially constant except for variations due to the flow of blood through the skin, tissue, muscle, etc. A constant attenuation can be determined and subtracted from the measured signal via traditional filtering techniques. However, when the patient moves, perturbations such as changing optical pathlengths occur. Such perturbations may be due to movement of background fluids, (such as venous blood, which has a different saturation than arterial blood). Therefore, the measured signal becomes erratic. Erratic, motion-induced noise typically cannot be predetermined and subtracted from the measured signal via traditional filtering techniques. Thus, determining the oxygen saturation of arterial blood and venous in erratic, motion-induced noise environments, blood becomes more difficult. Lamego at [0028] In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion. Lamego at [0029] In one embodiment, the physiological monitor utilizes a processor to determine a secondary reference signal n′(t) or Nref. The secondary reference signal n′(t) is used to determine the primary portion of the

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	measured signal. In one embodiment, the secondary reference signal n′(t) is input to a multi-variate process estimator, which removes the erratic, motion-induced secondary signal portions from the measured signal. In another embodiment, the processor determines a primary signal reference signal s′(t) which is used for display purposes or for input to a multi-variate process estimator to derive information about patient movement and venous blood oxygen saturation. Lamego at [0030] The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327. The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. Lamego at [0045] In the present embodiment, the output of the voltage to current converters 328 are switched such that, only one emitter is active at any given time. In addition, the voltage to current converter for the inactive emitter is switched off at its input as well, such that it is deactivated. This reduces noise from the switching and voltage to current conversion circuitry. In the present embodiment, low noise voltage to current converters 328 are selected (e.g., Op 27 Op Amps), and the feedback loop is configured to have a low pass filter to reduce noise. In the present embodiment, the low pass filtering function of the voltage to current converters 328 has a corner frequency of just above 625 Hz, which is the switching speed for the emitters 302, as further discussed below. Accordingly, the driver circuit embodiment of FIG. 3A, minimizes the noise of the emitters 302. Lamego at [0047]

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	In the present embodiment, the multi-variate process estimator 531 includes a pseudo-inverse, as is known to those of skill in the art. In another embodiment, the multi-variate process estimator 531 is formed by a joint process estimator and a low pass filter. Details of a suitable joint process estimator are provided in U.S. Pat. No. 5,632,272, incorporated by reference herein. However, it will be understood by those of skill in the art that a variety of such processing structures may be utilized. For example, in another embodiment, a correlation canceller, an adaptive linear combiner, an adaptive noise filter (e.g., as shown in FIG. 10A), an adaptive noise canceller, an adaptive linear lattice, a neural network, a radial basis, or a voltera are used individually or in combination, instead of or in addition to the pseudo-inverse embodiment of the multi-variate process estimator 531. Such processing structures are well known to those of skill in the art, and require no further explanation herein. Lamego at [0086] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Lamego discloses or renders obvious wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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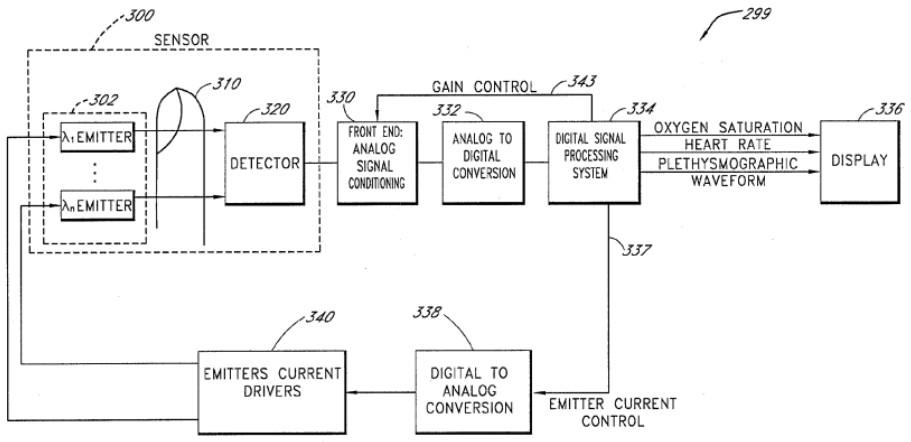
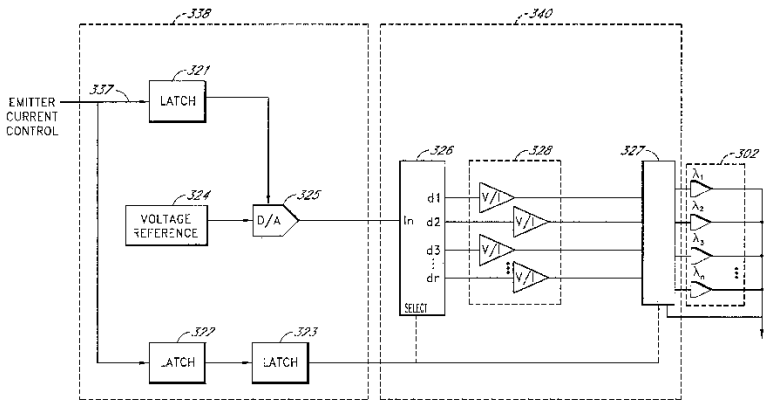
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	Claim 14
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Lamego discloses or renders obvious wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above. Blood oxygen saturation measurement systems, oximeters, and physiological monitors of the prior art generally utilize two different wavelengths of light to determine a patient's blood oxygen saturation level. In general, such systems provide two wavelengths of light to a target location on a patient's body. The systems then measure at least one signal indicative of the transmission or reflection of the two light wavelengths with respect to the tissue at the target location. Lamego at [0005] A practical application of this technique is pulse oximetry, which utilizes a noninvasive sensor to measure blood oxygen saturation (SpO2) and pulse rate. A multi-wavelength physiological monitor in accordance with one embodiment determines blood oxygen saturation by propagating multi-wavelength energy through a medium, such as a portion of a patient's body where blood flows close to the body surface. For example, in one embodiment, energy is propagated through an ear lobe, a digit (such as a finger or toe), a forehead, or a scalp (such as a fetus's scalp). An attenuated signal is measured after energy propagation through, or reflection from the medium. The physiological monitor determines the saturation of oxygenated blood in the patient based at least in part upon the measured signal. Lamego at [0024] In one embodiment, absorption measurements are based upon the transmission of energy through a medium. In one embodiment, multiple light emitting diodes (LEDs) are positioned on one side of a portion of the body where blood flows close to the body's surface, such as a finger, and a photodetector is positioned on the opposite side of the surface. In another embodiment one or more such LEDs emit light of different wavelengths. In one embodiment, one LED emits a visible wavelength, such as red, and

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	the other LED emits an infrared wavelength. However, one skilled in the art will realize that other wavelength combinations could be used. Lamego at [0027] A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] FIG. 3A illustrates one embodiment of the drivers 340 and the digital to analog conversion circuit 338. As depicted in FIG. 3A, the digital-to-analog conversion circuit 338 includes first and second input latches 321, 322, a synchronizing latch 323, a voltage reference 324, and a digital to analog conversion circuit 325. The emitter current drivers 340 include first and second switch banks 326, 327, and n voltage to current converters 328. LED emitters 302 of FIG. 3 are coupled to the output of the emitter current drives 340. Lamego at [0044] The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter

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	circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327. The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. Lamego at [0045] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Lamego discloses or renders obvious wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above.

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	 ***FIG. 3*** Lamego at Fig.3  ***FIG. 3A***

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	Lamego at Fig. 3A. A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327. The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. Lamego at [0045] In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further

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	processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a “saturation transform.” It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term “saturation transform” is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0051] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein	Lamego discloses or renders obvious wherein the first arc and the second arc are concentric.

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the first arc and the second arc are concentric.	*See* claim 15 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lamego discloses or renders obvious a wearable device for use with a smart phone or tablet. *See* claim 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	Lamego discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* claim 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Lamego discloses or renders obvious to generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths. A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] In the present embodiment, the n light emitters 302 are driven via the emitter current driver 340 to provide light transmission with digital modulation at 625 Hz. In the present embodiment, the n light emitters 302 are driven at a power level that provides an acceptable intensity for detection by the detector 320 and for conditioning by the front end analog signal conditioning circuitry 330. Once this energy level is determined for a given patient by the digital signal processing system 334, the current level for the n light emitters 302 is maintained substantially constant. It should be understood, however, that the current could be adjusted for changes in the ambient room light and other changes that would affect the voltage input to the front end analog signal conditioning circuitry 330. Lamego at [0050] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320

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	is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0051]. FIG. 7 illustrates one embodiment of the operation of the demodulation module 400. One embodiment of a composite, modulated signal format is depicted in FIG. 7. One full 625 Hz cycle of the n-wavelength, composite signal is depicted in FIG. 7 with the first ½n cycle including the first light wavelength signal plus ambient light signal, the second ½n cycle including an ambient light signal, the third ½n cycle including the second light wavelength signal plus ambient light signal, and the fourth ½n cycle including an ambient light signal. In one embodiment, this pattern repeats n times, wherein the (2n−1)th ½ n cycle includes the nth light wavelength signal plus an ambient light signal, and the 2nth cycle includes an ambient light signal. Lamego at [0066] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant's Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Lamego discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* claim 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant's Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue.	Lamego discloses or renders obvious the measurement device further comprising a receiver configured to:capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue. *See* claim 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Lamego discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor sources. *See* claim 11[a], 11[b], 11[g], 19[a], 19[b], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the	Lamego discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* claim 11[b], 11[h], 11[i], 11[j], 19[a], 19[d], 19[e].

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tissue by: differencing the first signal and the second signal, and	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Lamego discloses or renders obvious increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* claim 11[a] , 11[b], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Lamego discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* claim 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Lamego discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* claim 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link	Lamego discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link. *See* claim 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from	Lamego discloses or renders obvious wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 13, 19 above.

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the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Lamego discloses or renders obvious wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Lamego discloses or renders obvious wherein the first arc and the second arc are concentric. *See* claim 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D6

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EXHIBIT D7

U.S. Pat. No. 10,874,304 in view of U.S. Patent Publication No. 2010/0217102 to Steven Francis LeBoeuf et al. ("LeBoeuf")

As described in detail below, LeBoeuf (individually or collectively) anticipates and/or renders obvious claims 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D6 and D8-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. . This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in LeBoeuf. The cited portions of LeBoeuf are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of LeBoeuf. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that LeBoeuf "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found LeBoeuf does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in LeBoeuf (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in LeBoeuf anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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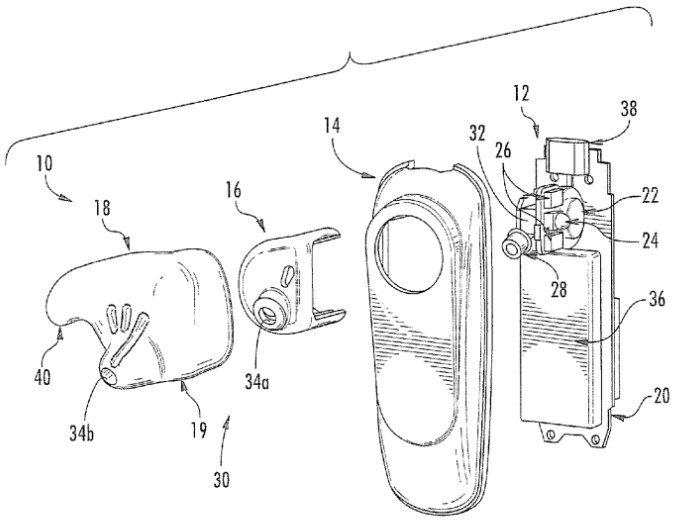
’304 Patent	LeBoeuf
Claim 11	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. LeBoeuf discloses or renders obvious a measurement system. **A monitoring device configured to be attached to the ear of a person includes a base**, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. **The base includes a speaker, an optical emitter, and an optical detector.** The cover includes light transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the device at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at Abstract. In some embodiments, **an earbud includes one or more sensor modules that includes one or more sensors for sensing physiological information and environmental information, such as noise**, for example. **As such, the earbud may function as a physiological monitor as well as an environmental monitor. In some embodiments, the earbud may include a microprocessor that is in electrical communication with the sensor module(s). For example, a microprocessor incorporated into an earbud may be configured to execute an adaptive filter algorithm to remove noise from at least one signal generated by a sensor module in the earbud. A microprocessor may also be configured to process information from the one or more sensors to generate a digital output string, wherein the digital output string includes a plurality of physiological and motion-related information.** LeBoeuf at [0025]. **Physiological sensors that may be incorporated into headsets and/or earbuds, according to some embodiments of the present invention, may be configured to detect and/or measure one or more of the following types of physiological information: heart rate, pulse rate, breathing rate, blood flow, VO2, VO2max, heartbeat signatures, cardio-pulmonary health, organ health, metabolism, electrolyte type and/or concentration, physical activity, caloric intake, caloric metabolism, blood metabolite levels or ratios, blood pH level, physical and/or psychological stress levels and/or stress level indicators, drug dosage and/or dosimetry, physiological drug reactions, drug chemistry,**

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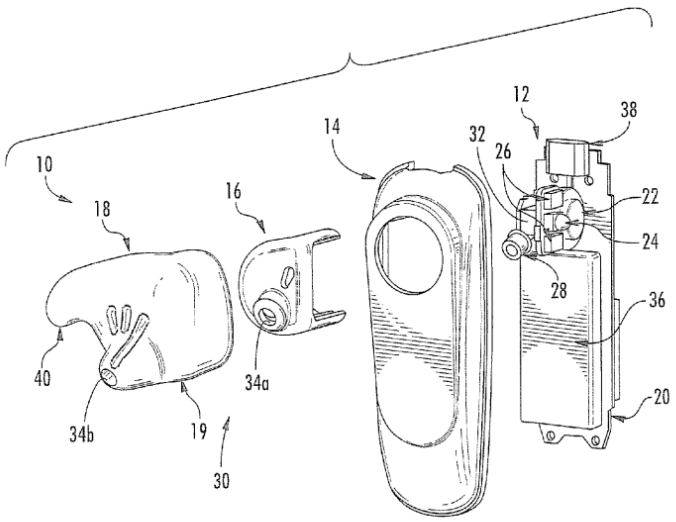
’304 Patent	LeBoeuf
	biochemistry, position and/or balance, body strain, neurological functioning, brain activity, brain waves, blood pressure, cranial pressure, hydration level, auscultatory information, auscultatory signals associated with pregnancy, physiological response to infection, skin and/or core body temperature, eye muscle movement, blood volume, inhaled and/or exhaled breath volume, physical exertion, exhaled breath physical and/or chemical composition, the presence and/or identity and/or concentration of viruses and/or bacteria, foreign matter in the body, internal toxins, heavy metals in the body, anxiety, fertility, ovulation, sex hormones, psychological mood, sleep patterns, hunger and/or thirst, hormone type and/or concentration, cholesterol, lipids, blood panel, bone density, organ and/or body weight, reflex response, sexual arousal, mental and/or physical alertness, sleepiness, auscultatory information, response to external stimuli, swallowing volume, swallowing rate, sickness, voice characteristics, voice tone, voice pitch, voice volume, vital signs, head tilt, allergic reactions, inflammation response, auto-immune response, mutagenic response, DNA, proteins, protein levels in the blood, water content of the blood, pheromones, internal body sounds, digestive system functioning, cellular regeneration response, healing response, stem cell regeneration response, etc. LeBoeuf at [0026]. **Light-guiding earbuds according to the various embodiments of the present invention may be utilized with mono headsets (i.e., headsets having one earbud) as well as stereo headsets (i.e., headsets having two earbuds). Additionally, the light-guiding region of earbuds, according to embodiments of the present invention, may be integrated not only into an earbud cover and earbud housing, but also into each or all components of an earbud. Moreover, light-guiding earbuds according to the various embodiments of the present invention may be utilized with hearing aids, body jewelry, or any other attachment that can be placed near the head region, such as eye glasses or shades, a headband, a cap, helmet, visor, or the like.** LeBoeuf at [0029]. The present invention will now be described more fully hereinafter with reference to the accompanying figures, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Like numbers refer to like elements throughout. In the figures, certain layers, components or features may be

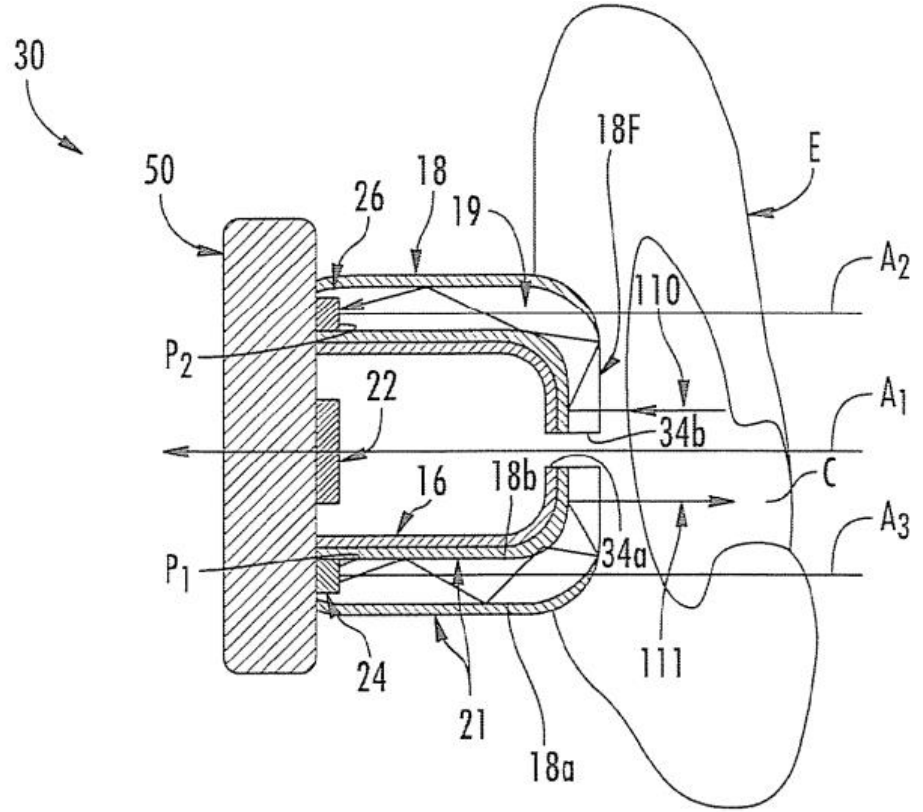
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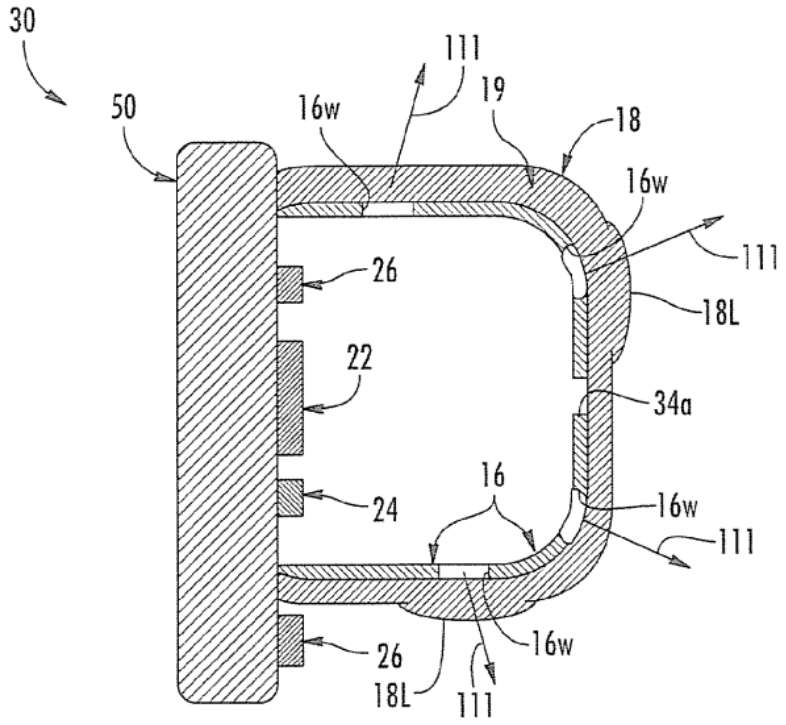
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	exaggerated for clarity, and broken lines illustrate optional features or operations unless specified otherwise. In addition, the sequence of operations (or steps) is not limited to the order presented in the figures and/or claims unless specifically indicated otherwise. Features described with respect to one figure or embodiment can be associated with another embodiment or figure although not specifically described or shown as such. LeBoeuf at [0073]. **Wireless, Bluetooth®-enabled, and/or other personal communication headsets may be configured to incorporate physiological and/or environmental sensors, according to some embodiments of the present invention. As a specific example, Bluetooth® headsets are typically lightweight, unobtrusive devices that have become widely accepted socially. Moreover, Bluetooth® headsets are cost effective, easy to use, and are often worn by users for most of their waking hours while attending or waiting for cell phone calls. Bluetooth® headsets configured according to embodiments of the present invention are advantageous because they provide a function for the user beyond health monitoring, such as personal communication and multimedia applications, thereby encouraging user compliance. Exemplary physiological and environmental sensors that may be incorporated into a Bluetooth® or other type of headsets include, but are not limited to accelerometers, auscultatory sensors, pressure sensors, humidity sensors, color sensors, light intensity sensors, pressure sensors, etc.** LeBoeuf at [0086]. Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated **headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16**. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, **optical emitter 24, optical detectors 26,** and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, **optical emitter 24, optical detectors 26,** and thermopile 28. **Collectively, the earbud housing 16, cover 18, and various electronic components (e.g., speaker 22, optical emitter 24, optical detectors 26, thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30.**

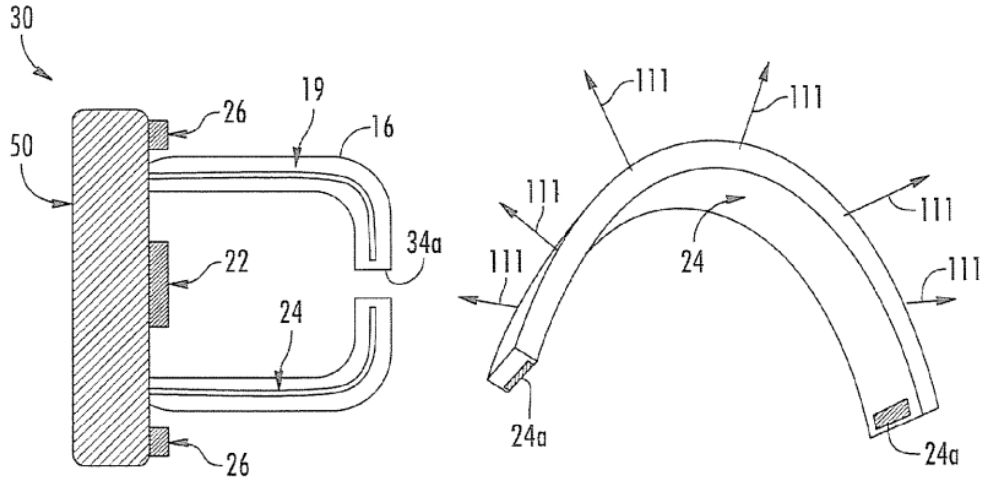
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	LeBoeuf at [0091].  FIG. 1 LeBoeuf at Fig. 1. The illustrated cover 18 of FIG. 1 includes an alignment member 40 (also referred to as a stabilization arm) that facilitates alignment of the earbud 30 within an ear canal of a subject. **The alignment member 40 may facilitate stable measurements of optical scattered light from the ear region, which can be important for PPG measurements and tympanic temperature measurements.** LeBoeuf at [0099]. The multiplexed data outputs 604 may be a serial data string of activity and physiological information 700 (FIG. 18) parsed out specifically such that an application-specific interface (API) can utilize the data as required for a particular application. The applications may use this data to generate high-level assessments, such as overall fitness or overall health. Furthermore, the individual data elements of the data string can be used to facilitate better assessments of other individual data elements of the data string.

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	As a specific example, the Blood Flow data string may contain information on the first and second derivatives of each blood pulse. This information may be processed from a PPG signal by running the adaptively filtered heart rate signal through a slope-finder algorithm (such as a differentiator circuit). In another example, the filtered PPG signal may be run through an integration circuit to estimate blood volume over each blood pulse. **This information may then be used to assess blood pressure and blood oxygen levels more accurately than a direct measurement of blood pressure or blood oxygen levels.** LeBoeuf at [0150]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	LeBoeuf discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths. In some embodiments, **an earbud includes one or more sensor modules that includes one or more sensors for sensing physiological information and environmental information, such as noise, for example. As such, the earbud may function as a physiological monitor as well as an environmental monitor**. In some embodiments, the earbud may include a microprocessor that is in electrical communication with the sensor module(s). For example, a microprocessor incorporated into an earbud may be configured to execute an adaptive filter algorithm to remove noise from at least one signal generated by a sensor module in the earbud. **A microprocessor may also be configured to process information from the one or more sensors to generate a digital output string, wherein the digital output string includes a plurality of physiological and motion-related information**. LeBoeuf at [0025].

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	Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated **headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16**. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, **optical emitter 24, optical detectors 26,** and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, **optical emitter 24, optical detectors 26,** and thermopile 28. **Collectively, the earbud housing 16, cover 18, and various electronic components (e.g., speaker 22, optical emitter 24, optical detectors 26, thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30.** LeBoeuf at [0091].  FIG. 1 LeBoeuf at Fig. 1. Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. **The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD),** compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The

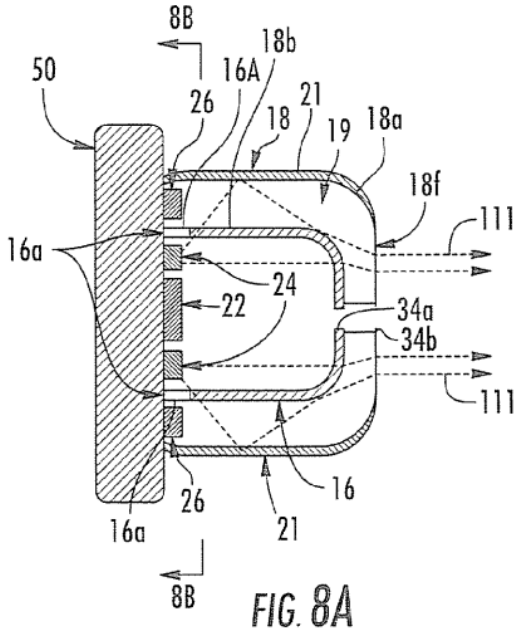
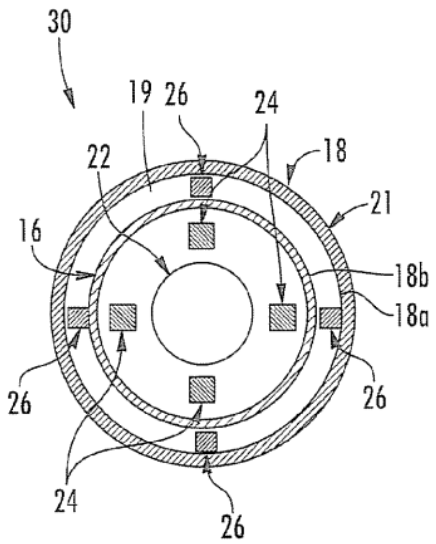
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	speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092].  FIG. 3 LeBoeuf at Fig. 3.

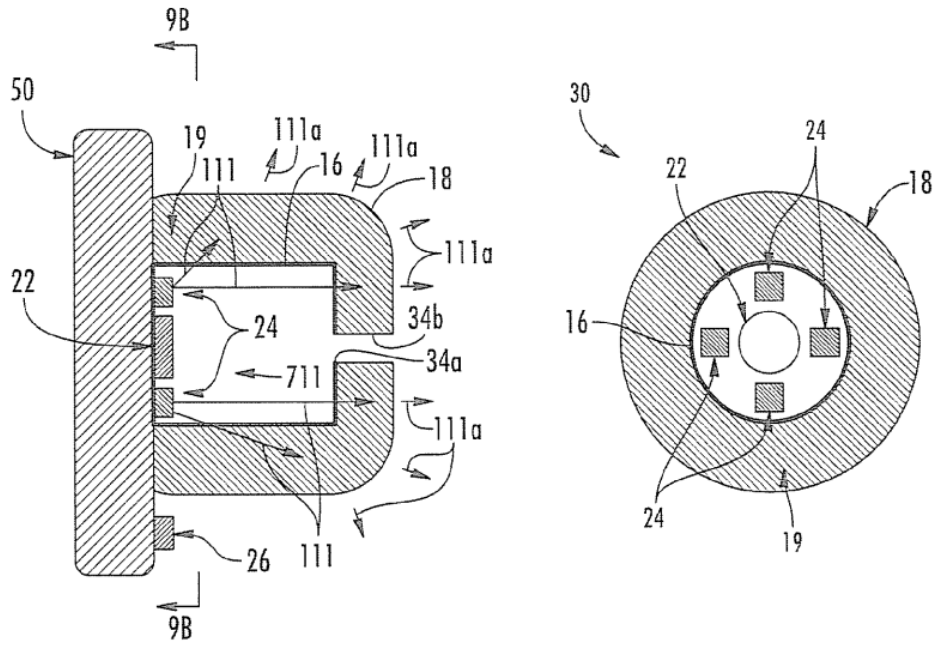
’304 Patent	LeBoeuf
	The illustrated cover 18 of FIG. 1 includes an alignment member 40 (also referred to as a stabilization arm) that facilitates alignment of the earbud 30 within an ear canal of a subject. **The alignment member 40 may facilitate stable measurements of optical scattered light from the ear region, which can be important for PPG measurements and tympanic temperature measurements.** LeBoeuf at [0099].  FIG. 6 LeBoeuf at Fig. 6. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-

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	factor of 24 shown in FIGS. 7A-7B, **where the flexible optical circuit may include one or more optical emitters** and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. **For example, these flexible devices may include an organic LED (OLED)** and an organic optical detector circuit. LeBoeuf at [0121].  FIG. 7A FIG. 7B LeBoeuf at Figs. 7A and 7B. The optical detectors 26 positioned outside the earbud housing 16 of the earbud 30 of FIGS. 7A-7B **collect scattered light from an ear originating from inspection light 111 generated by the flexible optical emitter 24**. **The flexible optical emitter 24 may be mounted to the earbud base 50 through one or more electrical connectors 24 a.** In some embodiments, these may be soldered, wired, or detachable connectors. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, **the flexible optical emitter 24 may be part of a flexible optical**

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	circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical emitters and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics**. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote locatio**n. **For example, these flexible devices may include an organic LED (OLED) and an organic optical detector circuit. This embodiment may be useful for generating a diffuse light beam towards the ear region and for detecting a diffuse optical scatter response from the ear region. In some embodiments, the emitter and detector on the flexible optical emitter 24 may be a traditional light-emitting diode (LED)** and photodetector (PD) integrated onto a flexible printed circuit board. In other embodiments, transparent solid state optical emitters, detectors, or switches may be used. For example, an electrically controlled liquid crystal matrix may be embedded within an earbud, **covering the flexible optical emitter 24. This may allow localized control of light flow to selected areas from/to the earbud going towards/away-from the ear. Additionally, this may allow localized control of light wavelength to selected areas.** LeBoeuf at [0122]. Referring now to FIGS. 8A-8B, **a light guiding earbud 30, according to some embodiments of the present invention,** includes a base 50, an earbud housing 16 extending outwardly from the base 50 that is configured to be positioned within an ear of a subject, and a cover 18 that surrounds the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the speaker 22 can pass. The cover 18 includes at least one aperture 34 b through which sound from the speaker 22 can pass. The cover 18 includes a cladding material 21 on the outer surface 18 a thereof, except at end portion 18 f, as illustrated. In the illustrated embodiment, there is no cladding material on the cover inner surface 18 b. The housing 16 is in contact with the cover inner surface 18 b and serves as a cladding layer to define the light guiding region 19**. The cover 18 with the illustrated cladding material 18 c serves as a light guide that delivers light from the optical emitters 24 into an ear canal of a subject through cover end portion 18 f. The cover 18 also collects light through end portion 18 f and delivers the collected light to the optical detectors 26. Various configurations and arrangements of optical emitters and detectors may be utilized in accordance with embodiments of the present invention.** LeBoeuf at [0123].

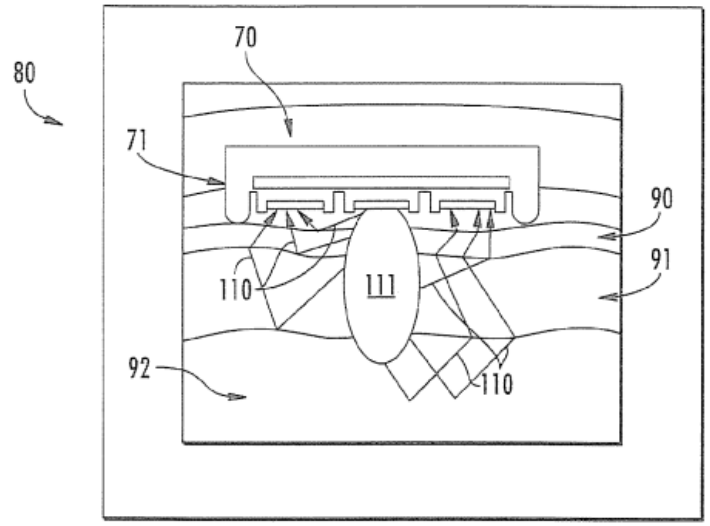
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	 FIG. 8A  FIG. 8B LeBoeuf at Figs. 8A and 8B. In the illustrated embodiment of FIGS. 8A-8B, **to reduce the risk of the inspection light 111** interrogating and saturating the optical detectors 26, a bottom portion 16 a of the earbud housing 16 includes a light blocking region that blocks light from passing therethrough. This light blocking region 16 a may be a black-painted region, an optically opaque region, or a material or structure that blocks light transmission. **The illustrated configuration of the earbud housing 16 and bottom portion 16 a may help confine inspection light 111 generated by the optical emitters 24 within the light-guiding layer (i.e., 19), guiding this light towards the ear region through the end portion 18 f of the earbud 30.** LeBoeuf at [0124]. Referring now to FIGS. 9A-9B**, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an earbud housing 16 extending outwardly from the base 50**

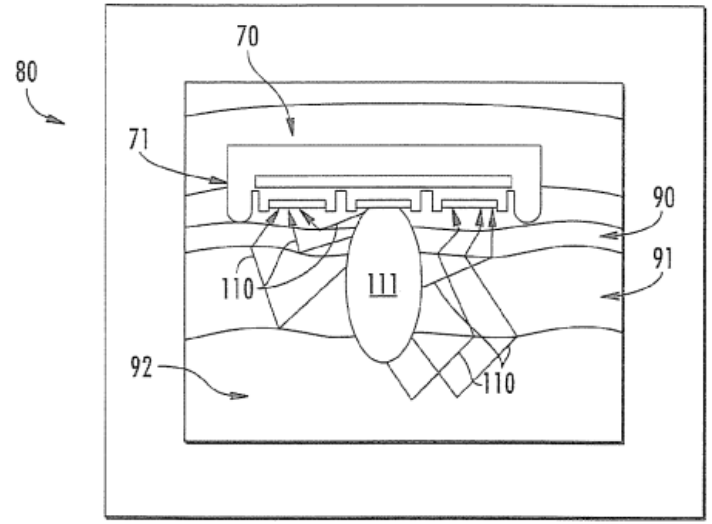
’304 Patent	LeBoeuf
	that is configured to be positioned within an ear of a subject, and a cover 18 surrounding the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the speaker 22 can pass. The cover 18 includes at least one aperture 34 b through which sound from the speaker 22 can pass. **A pair of optical emitters 24 are secured to the base 50 and are surrounded by the earbud housing 16, as illustrated**. An optical detector 26 is secured to the base 50 and is not surrounded by the earbud housing 16, as illustrated. **The cover 18 serves as a light guide that delivers light from the optical emitters 24 into an ear canal of a subject.** LeBoeuf at [0127].  FIG. 9A FIG. 9B LeBoeuf at Figs. 9A and 9B.

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	The light-guiding region 19 of the cover 18 is designed to diffuse light and/or to generate luminescence. In this embodiment, the light-guiding region 19 includes at least one optical scatter or luminescence region. The optical scatter or luminescence region may be located anywhere within the earbud in the optical path of the optical emitters 24, but preferably within or about the cladding layer itself. When inspection light 111 generated by the optical emitters 24 is scattered or by an optical scatter region, this light may form a more diffuse optical beam 111 a that is more uniform across the earbud 30 than the inspection light 111 generated by the optical emitters 24. This diffused beam, having an intensity distribution being less sensitive to motion of the ear, may be useful in alleviating motion artifacts in the scattered light coming from the ear, such that the scattered light coming from the ear, measured by the optical detector 26, is more indicative of blood flow changes within blood vessels and less indicative of mouth movements and body motion. **The optical scatter region within the light-guiding region 19 may be at least partially comprised of impurities or morphological differences within the light-guiding region.** An example of such impurities may include point defects, volume defects, native defects, metallics, polymers, microspheres, phosphors, luminescent particles, air pockets, particles, particulate matter, and the like. An example of morphological differences may include density variations, roughness, air pockets, stoichiometry variations, and the like. **As a specific example, the light-guiding region 19 may comprise a transparent material, such as glass, a polymer, or silicone, and a luminescent impurity, such as a phosphor or luminescent polymer or molecule, may be integrated within the light-guiding region. This configuration may generate luminescence within the light-guiding region 19 in response to optical excitation from the optical emitters 24. In other embodiments, nanoscale fluctuations or impurities may be used to diffuse or manipulate light through the earbud. Examples of nanoscale fluctuations or impurities may include quantum dots, rods, wires, doughnuts, or the like.** LeBoeuf at [0128]. FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring transmitted wavelengths. **The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths** 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains **one**

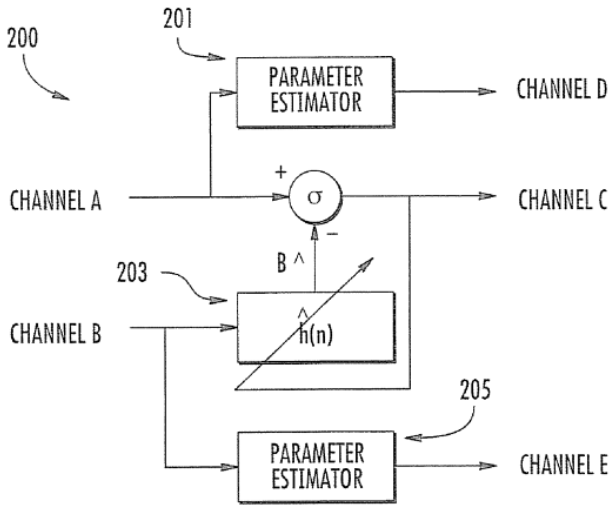
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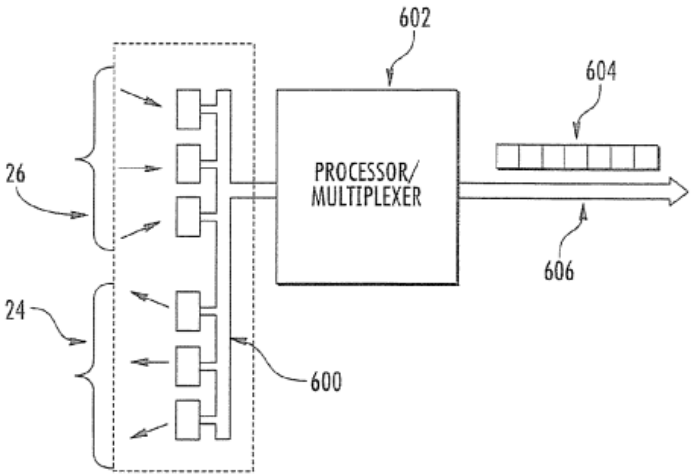
’304 Patent	LeBoeuf
	or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140].  FIG. 19 LeBoeuf at Fig.19. In the illustrated embodiment, **the light-guiding region 19 includes a light blocking member 80 that isolates light emitter 24** and light detector 26 from each other. In some embodiments, **multiple light emitters 24 may be utilized. For example, light emitters of different wavelengths may be utilized. In some embodiments, multiple light detectors may be utilized that are configured to measure light at different wavelengths (e.g., light detectors 26 and 26′ may be configured to measure light at different wavelengths).** LeBoeuf at [0169].

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	LeBoeuf discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring transmitted wavelengths. **The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths** 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains **one or more optical sources emitting one or more optical wavelengths,** as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140].

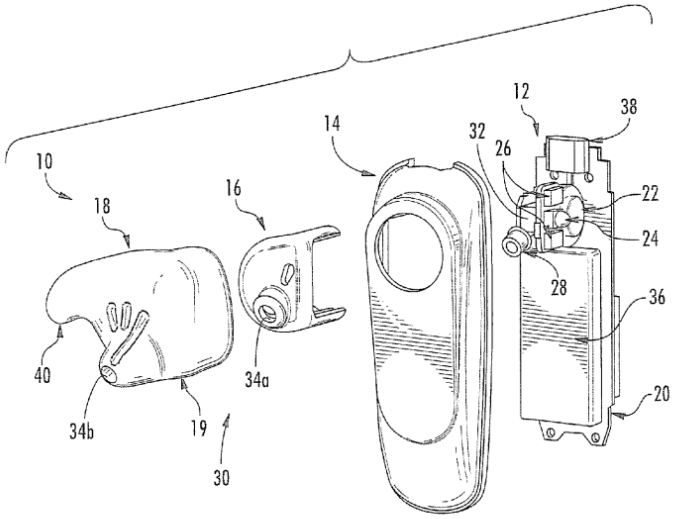
’304 Patent	LeBoeuf
	 FIG. 19 LeBoeuf at Fig.19. FIG. 13 illustrates the basic configuration of an adaptive noise cancellation scheme 200 for extracting a physiological signal from noise. The two types of sensor inputs are represented by the terms “Channel A” and “Channel B”. Channel A refers to inputs from sensors that collect physiological information plus noise information, and Channel B refers to inputs from sensors that collect primarily (or substantially) noise information. **Channel B information is passed through an electronic filter 203 whose properties are updated adaptively and dynamically. The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated.** LeBoeuf at [0143].

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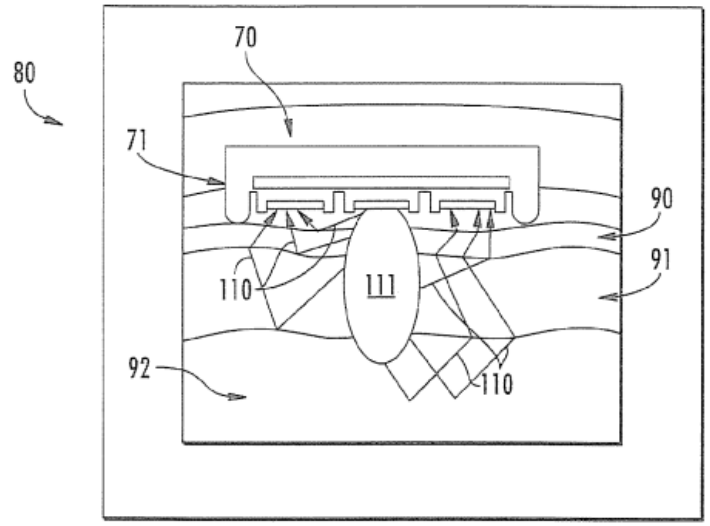
’304 Patent	LeBoeuf
	 FIG. 13 LeBoeuf at Fig. 13. **In some cases, it may be important to remove the effects of ambient optical noise from the physiological signal of a light-guiding earbud 30.** In such cases, one or more optical detectors 26 may be configured to measure outdoor or ambient lighting, and this information may be fed back into the processor 602 (FIG. 17) **to extract external optical noise from the physiological signal.** For example, some optical detectors may be configured to measure light from the ear, whereas others may be configured to measure light from the ambient environment, such as sunlight, room light, headlights, or the like. This may be achieved by directing the optical detectors towards and away from the ear, respectively. **In a specific example, the ambient light reaching the optical detectors 26 may generate an undesirable sinusoidal response on an optical detector that is configured to measure light from the ear. This undesirable sinusoidal noise response may be generated as an earbud user moves their head from side to side while running. Thus, Channel A of the adaptive filter 200 (FIG. 13) may include physiological information plus undesired ambient optical noise information. To remove this noise from the final output Channel C, the output of the optical detector configured to measure ambient optical noise may be an input (Channel B of FIG. 13) into the adaptive filter**

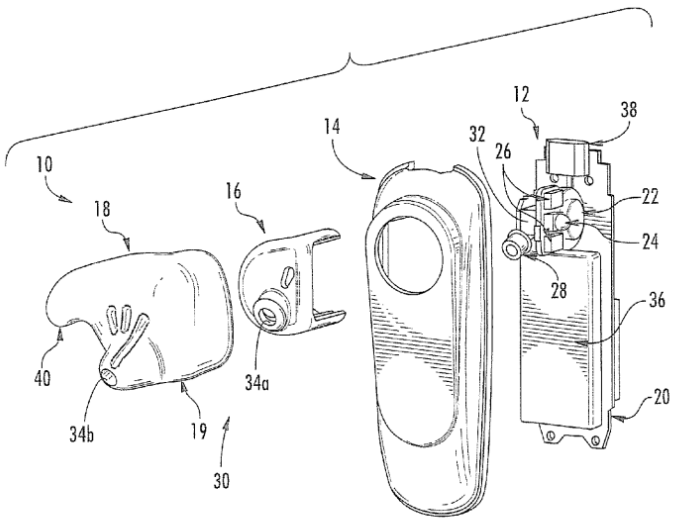
’304 Patent	LeBoeuf
	200. In this way, ambient noise from Channel A may be removed to generate a mostly physiological signal in Channel C. LeBoeuf at [0152]  FIG. 17 LeBoeuf at Fig.17 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
11[c]. the wearable measurement device	LeBoeuf discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample.

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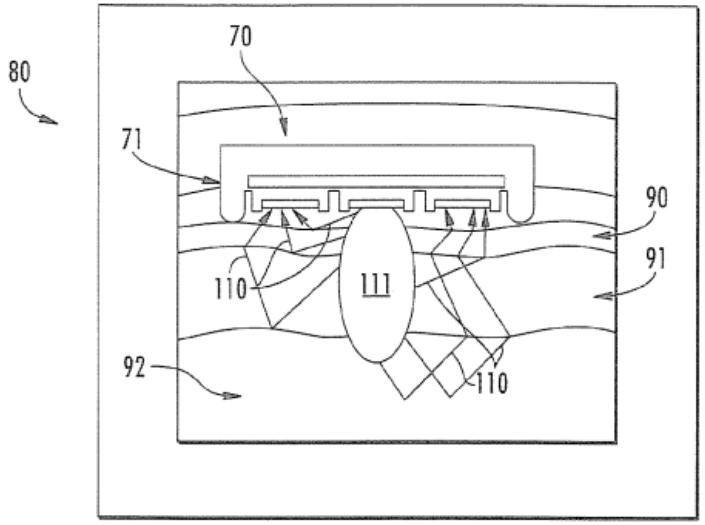
’304 Patent	LeBoeuf
configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated **headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16**. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, **optical emitter 24, optical detectors 26,** and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, **optical emitter 24, optical detectors 26,** and thermopile 28. **Collectively, the earbud housing 16, cover 18, and various electronic components (e.g., speaker 22, optical emitter 24, optical detectors 26, thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30.** LeBoeuf at [0091]  FIG. 1 LeBoeuf at Fig. 1. Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. **The optical emitter 24 may be a light-emitting diode (LED), laser**

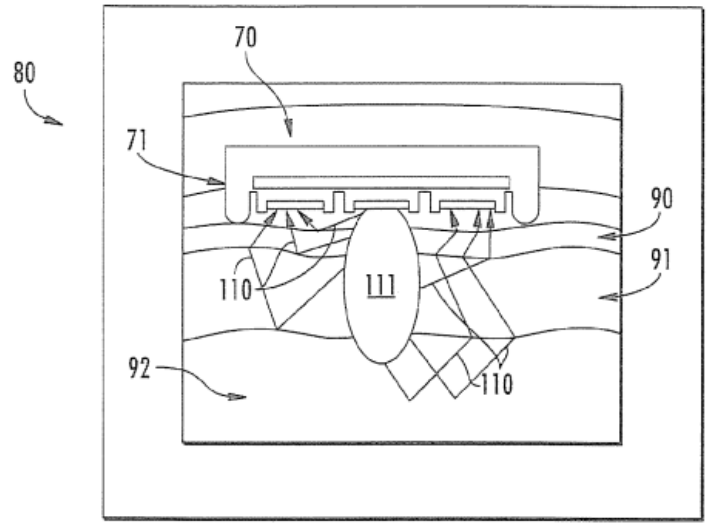
’304 Patent	LeBoeuf
	diode (LD), compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092] The illustrated cover 18 of FIG. 1 includes an alignment member 40 (also referred to as a stabilization arm) that facilitates alignment of the earbud 30 within an ear canal of a subject. **The alignment member 40 may facilitate stable measurements of optical scattered light from the ear region, which can be important for PPG measurements and tympanic temperature measurements.** LeBoeuf at [0099] In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, **where the flexible optical circuit may include one or more optical emitters** and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. **For example, these flexible devices may include an organic LED (OLED)** and an organic optical detector circuit. LeBoeuf at [0122] **FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured,** as opposed to measuring transmitted wavelengths. **The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths** 111 and monitor the resulting scattered optical energy 110. The optical source-detector

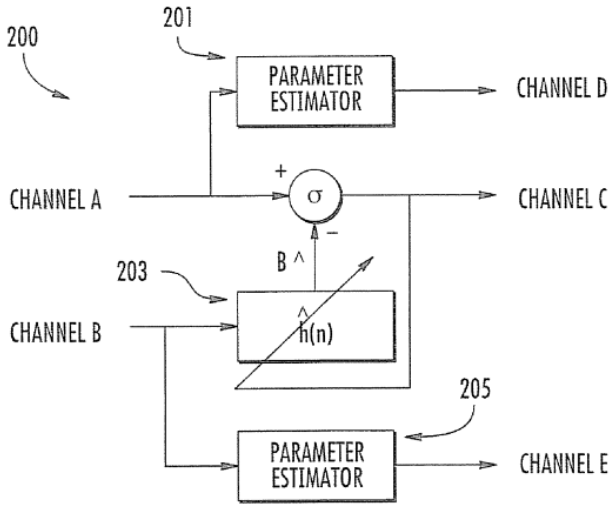
’304 Patent	LeBoeuf
	assembly 71 contains **one or more optical sources emitting one or more optical wavelengths,** as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140]  FIG. 19 LeBoeuf at Fig.19. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d]. the wearable measurement device further	LeBoeuf discloses or renders obvious the wearable measurement device further comprising a receiver.

’304 Patent	LeBoeuf
comprising a receiver configured to:	Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated **headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16**. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, **optical emitter 24, optical detectors 26,** and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, optical emitter 24**, optical detectors 26,** and thermopile 28. Collectively, the earbud housing 16, cover 18, and various electronic components (e.g., speaker 22, optical emitter 24, **optical detectors 26,** thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30. LeBoeuf at [0091]  FIG. 1 LeBoeuf at Fig. 1. **Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like.** The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD), compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The

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	speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092] The illustrated cover 18 of FIG. 1 includes an alignment member 40 (also referred to as a stabilization arm) that facilitates alignment of the earbud 30 within an ear canal of a subject. **The alignment member 40 may facilitate stable measurements of optical scattered light from the ear region, which can be important for PPG measurements and tympanic temperature measurements.** LeBoeuf at [0099] In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, **where the flexible optical circuit may include one or more optical emitters** and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. For example, these flexible devices may include an organic LED (OLED**)** and **an organic optical detector circuit.** LeBoeuf at [0122] FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring transmitted wavelengths. The optical emitter **and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths** 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains one

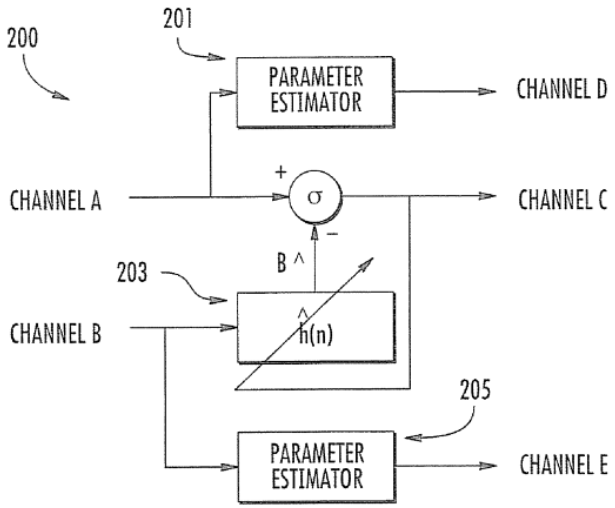
’304 Patent	LeBoeuf
	or more optical sources emitting one or more optical wavelengths, **as well as one or more optical detectors detecting one or more optical wavelengths.** LeBoeuf at [0140]  FIG. 19 LeBoeuf at Fig.19 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis	LeBoeuf discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample.

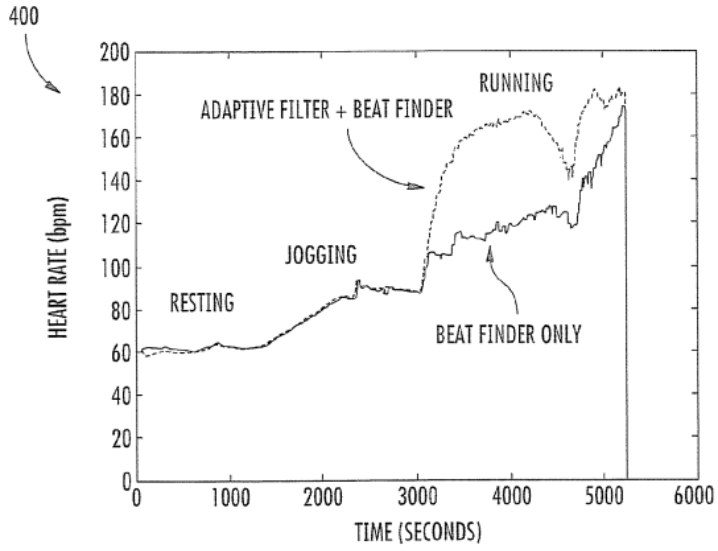
’304 Patent	LeBoeuf
output beam reflected or transmitted from the sample,	**FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured,** as opposed to measuring transmitted wavelengths. The optical emitter **and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths** 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains one or more optical sources emitting one or more optical wavelengths, **as well as one or more optical detectors detecting one or more optical wavelengths.** LeBoeuf at [0140]  FIG. 19 LeBoeuf at Fig.19

’304 Patent	LeBoeuf
	FIG. 13 illustrates the basic configuration of an adaptive noise cancellation scheme 200 for extracting a physiological signal from noise. The two types of sensor inputs are represented by the terms “Channel A” and “Channel B”. Channel A refers to inputs from sensors that collect physiological information plus noise information, and Channel B refers to inputs from sensors that collect primarily (or substantially) noise information. Channel B information is passed through an electronic filter 203 whose properties are updated adaptively and dynamically. **The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated.** LeBoeuf at [0143]  FIG. 13 LeBoeuf at Fig.13

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	LeBoeuf discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. **The physiological sensors of the sensor module may generate a signal that includes physiological information plus noise information**. The noise may be removed by combining the physiological information and noise information from the sensor module with noise information from the noise source of the sensor module via an electronic filtering method, such as a signal processing technique. Specific examples of such signal processing techniques include FIR (Finite Impulse Response), IIR (Infinite Impulse Response), informatics, machine learning, and adaptive filter methods. **The output of the adaptive filter may be a physiological signal that is wholly or partially free of noise. In some embodiments, motion-related noise from a subject activity such as running may be removed from the physiological plus noise signal generated by a photoplethysmography (PPG) sensor for measuring blood constituent levels or blood flow properties, such as blood oxygen level, VO2, or heart rate.** LeBoeuf at [0022] In some embodiments of the present invention, **a processor/multiplexor processes physiological signals and noise signals into a data string. This data string may contain information relating to physiological information and motion-related information. The processing method may include signal processing techniques such as pre-adaptive signal conditioning, adaptive filtering, and parameter extraction**. LeBoeuf at [0024].

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	In some embodiments**, an earbud includes one or more sensor modules that includes one or more sensors for sensing physiological information and environmental information, such as noise, for example. As such, the earbud may function as a physiological monitor as well as an environmental monitor.** In some embodiments, the earbud may include a microprocessor that is in electrical communication with the sensor module(s). For example, a microprocessor incorporated into an earbud may be configured to execute an adaptive filter algorithm to remove noise from at least one signal generated by a sensor module in the earbud. A **microprocessor may also be configured to process information from the one or more sensors to generate a digital output string, wherein the digital output string includes a plurality of physiological and motion-related information.** LeBoeuf at [0025]. FIG. 13 illustrates the basic configuration of an adaptive noise cancellation scheme 200 for extracting a physiological signal from noise. The two types of sensor inputs are represented by the terms “Channel A” and “Channel B”. Channel A refers to inputs from sensors that collect physiological information plus noise information, and Channel B refers to inputs from sensors that collect primarily (or substantially) noise information. Channel B information is passed through an electronic filter 203 whose properties are updated adaptively and dynamically. The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and **Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated.** LeBoeuf at [0143]

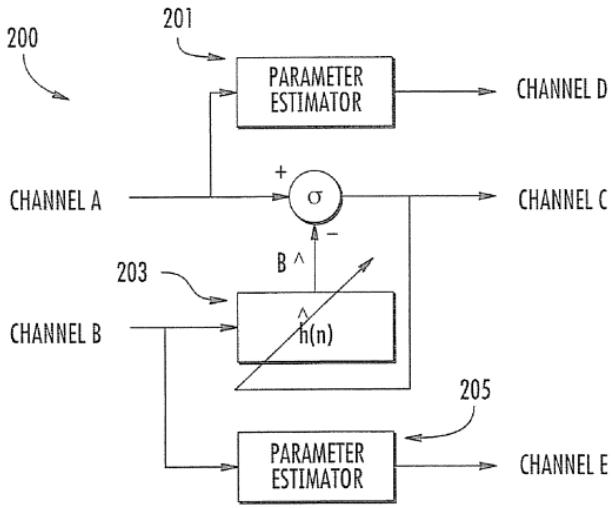
’304 Patent	LeBoeuf
	 FIG. 13 LeBoeuf at Fig.13 **FIG. 15 is a graph of processed physiological signal data from a headset having one or more light-guiding earbuds 30, according to some embodiments of the present invention. Specifically, FIG. 15 shows the analysis results 400 of the data summaries 300 a-300** d presented in FIGS. 14A-14D of blood flow (y-axis) versus time (x-axis) following two data processing sequences to extract heart rate. One sequence incorporated the adaptive filtering process 200 of FIG. 13 as well as a beat finder processing step. The second sequence incorporated the beat finder processing step without the adaptive filtering process 200 of FIG. 13. **The beat finder process counts each heart beat by monitoring the peaks and valleys of each pulse, such as the peaks and valleys shown in the graph 300 a of FIG. 14A. As shown in FIG. 15, the beat finder was effective at measuring heart rate during resting and jogging. However, the beat finder alone was not sufficient for monitoring heart rate during running. This is because at high motion, the signal 300 d (FIG. 14D) associated with footsteps is strong enough to overwhelm the smaller signal associated with heart rate, and so the motion-related contribution dominated the overall signal 300 d.** Thus, the beat finder cannot distinguish heart beats from footsteps. By employing the adaptive filtering process 200 (FIG. 13) before the beat finder

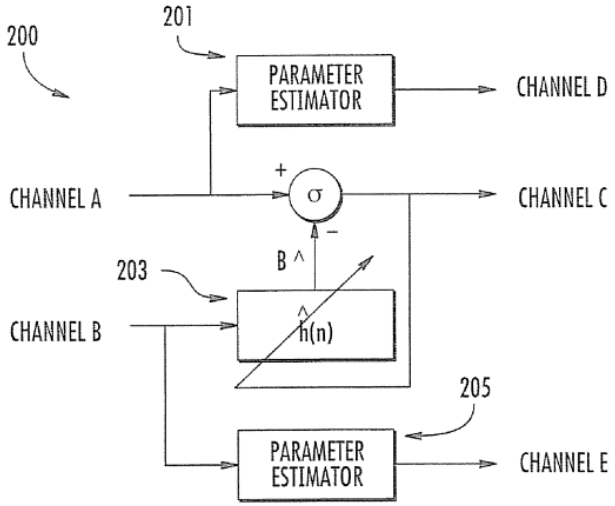
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	process, **the footstep motion artifacts during running were effectively removed from the sensor signal (Channel A of FIG. 13) such that the output signal (Channel C of FIG. 13) contained blood flow information with minimal motion artifacts. Thus, this output signal contained blood flow pulse signals that could then be “counted” by the beat finder to generate an accurate heart rate assessment.** LeBoeuf at [0147]  FIG. 15 LeBoeuf at Fig.15 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it

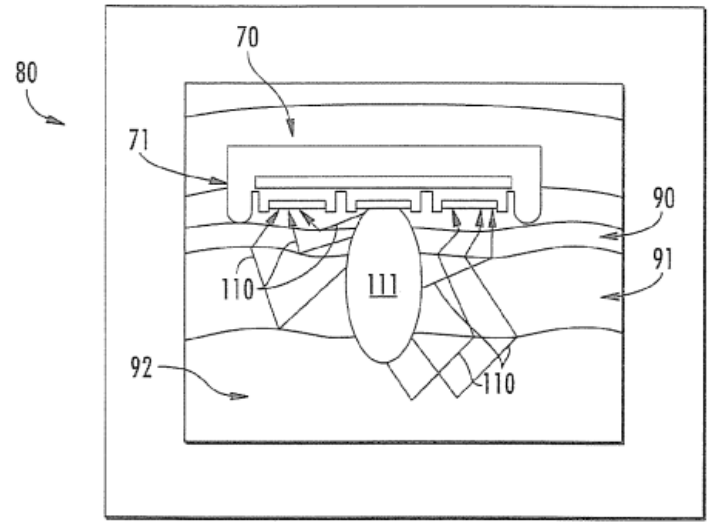
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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	LeBoeuf discloses or renders obvious the receiver configured to synchronize to the light source. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the captured light into a first signal,	LeBoeuf discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal. **FIG. 13 illustrates the basic configuration of an adaptive noise cancellation scheme 200 for extracting a physiological signal from noise. The two types of sensor inputs are represented by the terms “Channel A” and “Channel B”.** Channel A refers to inputs from sensors that collect physiological information plus noise information, and **Channel B refers to inputs from sensors that collect primarily (or substantially) noise information. Channel B information is passed through an electronic filter 203 whose properties are updated adaptively and dynamically.** The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated. LeBoeuf at [0143]

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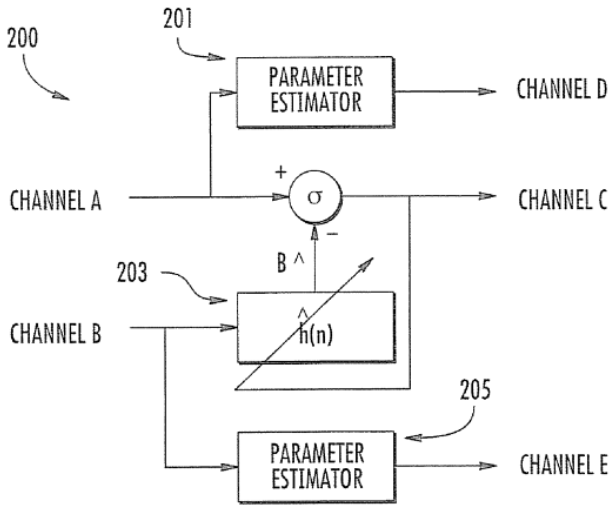
’304 Patent	LeBoeuf
	 FIG. 13 LeBoeuf at Fig.13 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a	LeBoeuf discloses or renders obvious the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. FIG. 13 illustrates the basic configuration of an adaptive noise cancellation scheme 200 for extracting a physiological signal from noise. **The two types of sensor inputs are represented by the terms**

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portion of the analysis output beam reflected or transmitted from the sample,	**“Channel A” and “Channel B”. Channel A refers to inputs from sensors that collect physiological information plus noise information,** and Channel B refers to inputs from sensors that collect primarily (or substantially) noise information. Channel B information is passed through an electronic filter 203 whose properties are updated adaptively and dynamically. The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and **Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated.** LeBoeuf at [0143]  FIG. 13 LeBoeuf at Fig.13 FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring transmitted wavelengths. **The optical emitter**

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	and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains **one or more optical sources emitting one or more optical wavelengths,** as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140]  FIG. 19 LeBoeuf at Fig.19 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	LeBoeuf discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. FIG. 13 illustrates the basic configuration of an adaptive noise cancellation scheme 200 for extracting a physiological signal from noise. The two types of sensor inputs are represented by the terms “Channel A” and “Channel B”. Channel A refers to inputs from sensors that collect physiological information plus noise information, and Channel B refers to inputs from sensors that collect primarily (or substantially) noise information. **Channel B information is passed through an electronic filter 203 whose properties are updated adaptively and dynamically. The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated.** LeBoeuf at [0143]

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	 FIG. 13 LeBoeuf at Fig.13 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch	LeBoeuf discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link.

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screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	**Wireless, Bluetooth®-enabled, and/or other personal communication headsets may be configured to incorporate physiological and/or environmental sensors, according to some embodiments of the present invention.** As a specific example, Bluetooth® headsets are typically lightweight, unobtrusive devices that have become widely accepted socially. **Moreover, Bluetooth® headsets are cost effective, easy to use, and are often worn by users for most of their waking hours while attending or waiting for cell phone calls**. **Bluetooth® headsets configured according to embodiments of the present invention are advantageous because they provide a function for the user beyond health monitoring, such as personal communication and multimedia applications, thereby encouraging user compliance.** Exemplary physiological and environmental sensors that may be incorporated into a Bluetooth® or other type of headsets include, but are not limited to accelerometers, auscultatory sensors, pressure sensors, humidity sensors, color sensors, light intensity sensors, pressure sensors, etc. LeBoeuf at [0086] The main circuit board 20 and secondary circuit board 32 may also support one or more sensor modules (not shown) that contain various physiological and/or environmental sensors. For example, a sensor module, such as sensor module 70 illustrated in **FIGS. 12A-12B, may be attached to the circuit boards 20, 32. The circuit boards 20, 32 also may include at least one signal processor (not shown), at least one wireless module (not shown) for communicating with a remote device,** and/or at least one memory storage device (not shown). **An exemplary wireless module may include a wireless chip, antenna, or RFID tag. In some embodiments, the wireless module may include a low-range wireless chip or chipset, such as a Bluetooth® or ZigBee chip. These electronic components may be located on the main circuit board 20, or on another circuit board, such as the secondary circuit board 32, attached to the main circuit board.** LeBoeuf at [0093] In some embodiments, these may be soldered, wired, or detachable connectors. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical emitters and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. **In some**

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	embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location LeBoeuf at [0122] 39. The device of claim 33, wherein **the base comprises a transmitter configured to transmit signals processed by the signal processor to a remote device.** LeBoeuf at Claim 39. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	LeBoeuf discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. **Wireless, Bluetooth®-enabled, and/or other personal communication headsets may be configured to incorporate physiological and/or environmental sensors, according to some embodiments of the present invention.** As a specific example, Bluetooth® headsets are typically lightweight, unobtrusive devices that have become widely accepted socially. **Moreover, Bluetooth® headsets are cost effective, easy to use, and are often worn by users for most of their waking hours while attending or waiting for cell phone calls**. **Bluetooth® headsets configured according to embodiments of the present invention are advantageous because they provide a function for the user beyond health monitoring, such as personal communication and multimedia applications, thereby encouraging user compliance.** Exemplary physiological and environmental sensors that may be incorporated into a

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	Bluetooth® or other type of headsets include, but are not limited to accelerometers, auscultatory sensors, pressure sensors, humidity sensors, color sensors, light intensity sensors, pressure sensors, etc. LeBoeuf at [0086] The main circuit board 20 and secondary circuit board 32 may also support one or more sensor modules (not shown) that contain various physiological and/or environmental sensors. For example, a sensor module, such as sensor module 70 illustrated in **FIGS. 12A-12B, may be attached to the circuit boards 20, 32. The circuit boards 20, 32 also may include at least one signal processor (not shown), at least one wireless module (not shown) for communicating with a remote device,** and/or at least one memory storage device (not shown). **An exemplary wireless module may include a wireless chip, antenna, or RFID tag. In some embodiments, the wireless module may include a low-range wireless chip or chipset, such as a Bluetooth® or ZigBee chip. These electronic components may be located on the main circuit board 20, or on another circuit board, such as the secondary circuit board 32, attached to the main circuit board.** LeBoeuf at [0093] In some embodiments, these may be soldered, wired, or detachable connectors. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical emitters and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. **In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location** LeBoeuf at [0122] 39. The device of claim 33, wherein **the base comprises a transmitter configured to transmit signals processed by the signal processor to a remote device.** LeBoeuf at Claim 39.

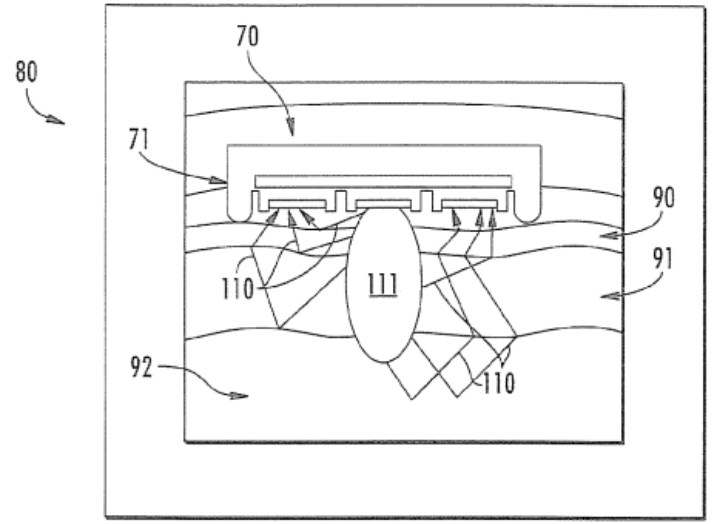
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. LeBoeuf discloses or renders obvious the measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	LeBoeuf discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it

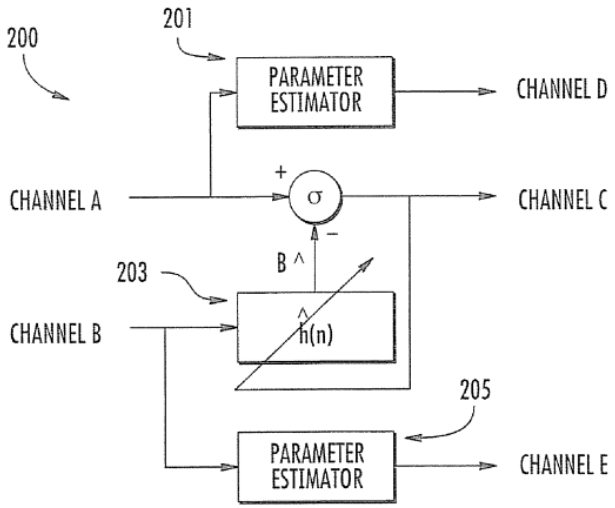
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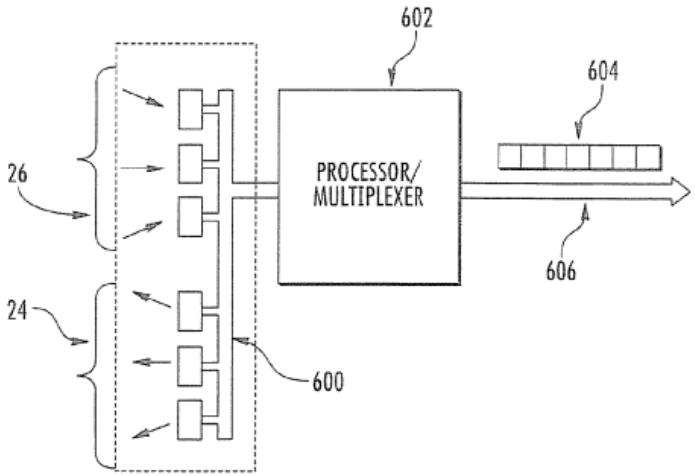
’304 Patent	LeBoeuf
	would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	LeBoeuf discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	LeBoeuf discloses or renders obvious the measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring transmitted wavelengths. **The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths** 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains **one or more optical sources emitting one or more optical wavelengths,** as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140]

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	 FIG. 19 LeBoeuf at Fig.19 FIG. 13 illustrates the basic configuration of an adaptive noise cancellation scheme 200 for extracting a physiological signal from noise. The two types of sensor inputs are represented by the terms “Channel A” and “Channel B”. Channel A refers to inputs from sensors that collect physiological information plus noise information, and Channel B refers to inputs from sensors that collect primarily (or substantially) noise information. **Channel B information is passed through an electronic filter 203 whose properties are updated adaptively and dynamically. The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated.** LeBoeuf at [0143]

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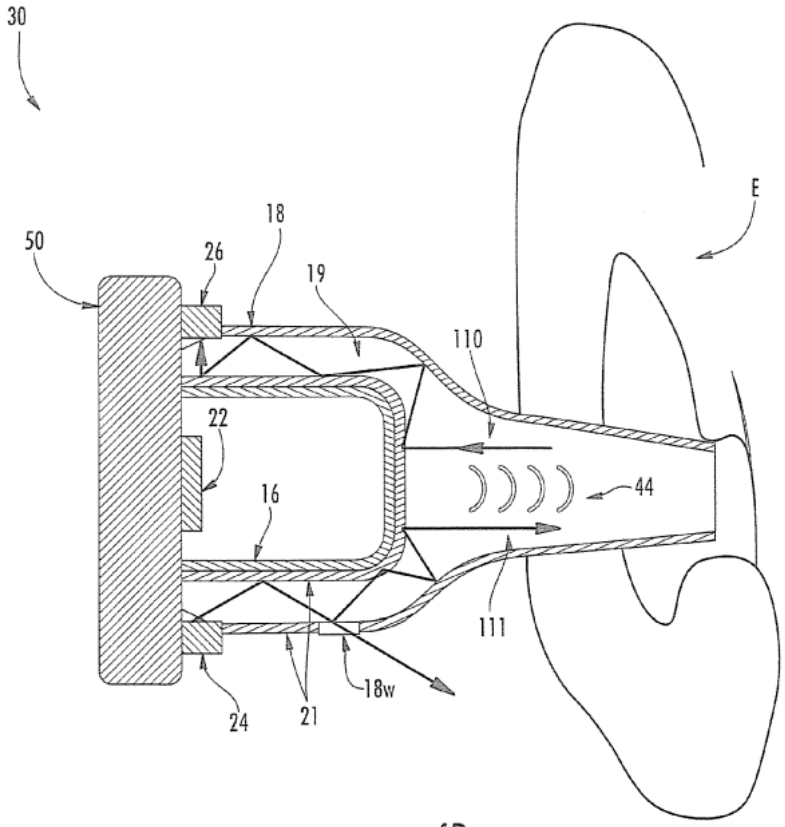
’304 Patent	LeBoeuf
	 FIG. 13 LeBoeuf at Fig.13 **In some cases, it may be important to remove the effects of ambient optical noise from the physiological signal of a light-guiding earbud 30.** In such cases, one or more optical detectors 26 may be configured to measure outdoor or ambient lighting, and this information may be fed back into the processor 602 (FIG. 17) **to extract external optical noise from the physiological signal.** For example, some optical detectors may be configured to measure light from the ear, whereas others may be configured to measure light from the ambient environment, such as sunlight, room light, headlights, or the like. This may be achieved by directing the optical detectors towards and away from the ear, respectively. **In a specific example, the ambient light reaching the optical detectors 26 may generate an undesirable sinusoidal response on an optical detector that is configured to measure light from the ear. This undesirable sinusoidal noise response may be generated as an earbud user moves their head from side to side while running. Thus, Channel A of the adaptive filter 200 (FIG. 13) may include physiological information plus undesired ambient optical noise information. To remove this noise from the final output Channel C, the output of the optical detector configured to measure ambient optical noise may be an input (Channel B of FIG. 13) into the adaptive filter**

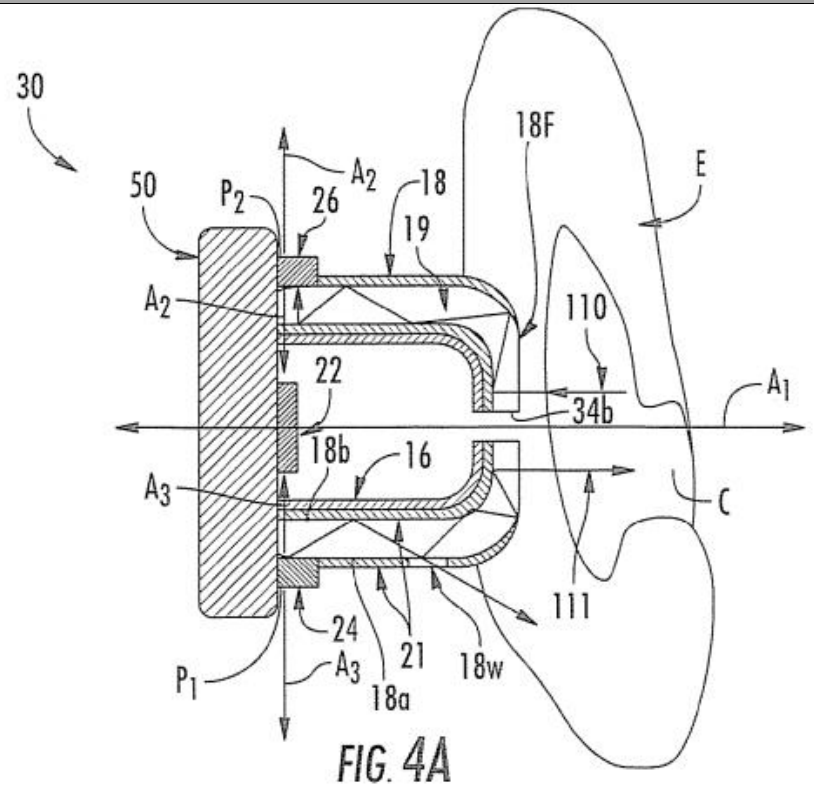
’304 Patent	LeBoeuf
	200. In this way, ambient noise from Channel A may be removed to generate a mostly physiological signal in Channel C. LeBoeuf at [0152]  FIG. 17 LeBoeuf at Fig.17 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	

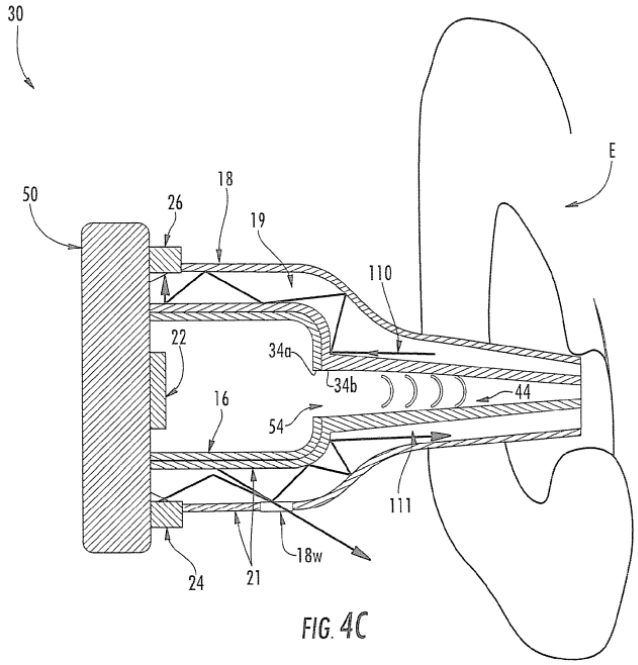
’304 Patent	LeBoeuf
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	LeBoeuf discloses or renders obvious the measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above. According to some embodiments of the present invention, a headset configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. **The base includes a speaker, an optical emitter**, and an optical detector. **The cover includes light transmissive material that is in optical communication with the optical emitter** and the optical detector and **serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the headset at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. The optical emitter, via the light-guiding cover, directs optical energy towards a particular region of ear and the optical detector detects secondary optical energy emanating from the ear region.** In some embodiments, the optical detector may include an optical filter configured to pass secondary optical energy at selective wavelengths. In some embodiments, **the light transmissive material of the cover may be configured, for example via the use of cladding and/or light reflective material, such that the cover serves as a light guide that is coupled in parallel to the optical emitter and detector. In some embodiments, the light transmissive material of the cover may be configured, for example via the use of cladding and/or light reflective material, such that the cover serves as a light guide that is coupled perpendicular to the optical emitter and detector.** LeBoeuf at [0006] In some embodiments, **the light transmissive material of the circular band has an outer surface and an inner surface, and a cladding material, such as light reflective material, is on (or near) at least a portion of one or both of the inner and outer surfaces.** LeBoeuf at [0032]

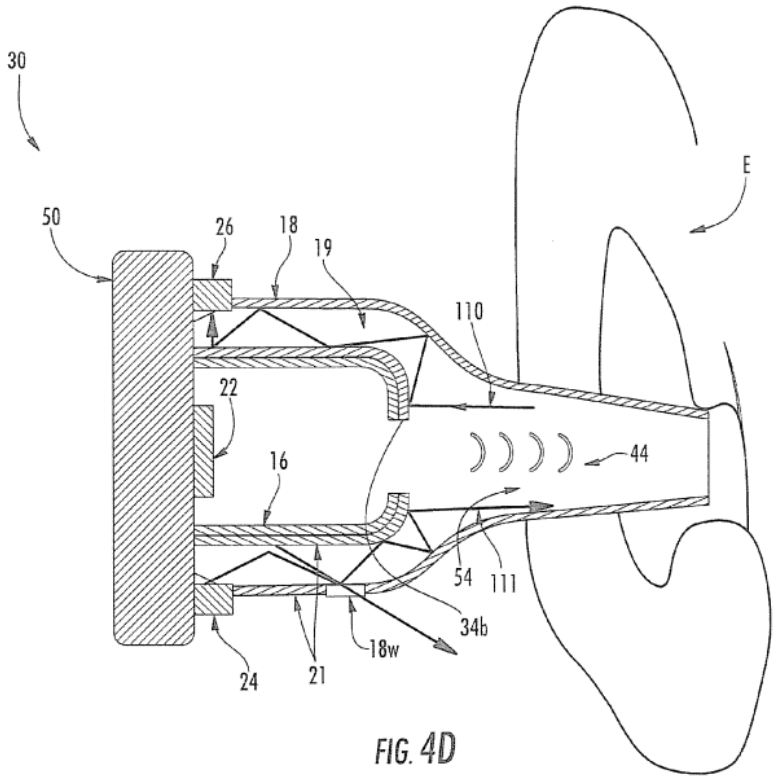
’304 Patent	LeBoeuf
	Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. **The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD),** compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092]. The cover 18 includes cladding material 21 on an inner surface 18 b thereof and on an outer surface 18 a thereof, as illustrated. An end portion 18 f of the cover outer surface 18 a does not have cladding material. **As such, the cover 18 serves as a light guide that delivers light from the optical emitter 24 through the end portion 18 f and into the ear canal C of a subject at one or more predetermined locations and that collects light external to the earbud housing 16 and delivers the collected light to the optical detector 26. In the various embodiments described herein, the terms light guide and cover are intended to be interchangeable. However, it should be noted that, in other embodiments, the earbud housing 16 may also serve as a light guide without the need for cover 18.** LeBoeuf at [0103]. **The optical emitter 24 generates inspection light 111 and the light-guiding region 19 of the light guide 18 directs the inspection light 111 towards an ear region. This light is called inspection light because it interrogates the surface of the ear, penetrates the skin of the ear, and generates a scattered light response 110 which may effectively inspect blood vessels within the ear region. The optical detector 26 detects scattered light 110 from an ear region and the light-guiding region 19 of the light guide 18 guides the light to the optical detector 26 through the light-guiding region 19, as illustrated.** LeBoeuf at [0105].

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	The light guiding region 19 of the light guide 18 in the illustrated embodiment of FIG. 3 is defined by cladding material 21 that helps confine light within the light guiding region 19. The cladding material 21 may be reflective material in some embodiments. In other embodiments, the cladding material may be optically transparent or mostly transparent with a lower index of refraction than the light transmissive material of the cover 18. The cladding 21 may be a layer of material applied to one or more portions of the inner and/or outer surfaces 18 a, 18 b of the light guide 18. In some embodiments, the outer surface 16 a of the earbud housing 16 may serve as cladding that confines light within the light-guiding region 19. In some embodiments, the light transmissive material of the light guide 18 may be composed of a material having a higher index of refraction than the cladding material 21. In some embodiments, air may serve as a cladding layer. LeBoeuf at [0107]. In the embodiment of FIG. 4A, **the light-guiding earbud 30 is configured for optical coupling that is substantially perpendicular to the light guide (i.e., cover 18). The optical detector 26 and optical emitter 24 are configured to detect and generate light substantially perpendicular to the light-guiding region 19 of the light guide 18. For example, the light guide 18 defines an axial direction A1. The optical emitter 24 and optical detector 26 are each oriented such that their respective primary emitting and detecting planes P1, P2 are each facing a respective direction A3, A2 that is substantially perpendicular to direction A1. The orientation of the optical emitter 24 and optical detector 26 in FIG. 4A may be convenient for manufacturing purposes, where side-emitting LEDs and side-detecting photodetectors can couple directly to the light-guiding region 19 for generating light 111 and detecting light 110. This may relax size constraints for an earbud 30 because the dimensions of the light-guiding region 19 may be independent of the optical emitter 24 and optical detector 26.** LeBoeuf at [0108]. **FIG. 4B illustrates the light-guiding earbud 30 of FIG. 4A modified such that the earbud cover 18 and cladding material 21 are elongated to reach deeper within the ear canal C of a subject, and closer to the tympanic membrane, for example. In the illustrated embodiment of FIG. 4B, there are no apertures in the housing 16 or cover 18. Acoustic energy 44 from/to the speaker/microphone**

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	passes through the material of the cover 18 and housing 16. The illustrated elongated configuration serves as both an optical light-guiding region and an acoustic wave-guiding region. LeBoeuf at [0109].  FIG. 4B LeBoeuf at Fig. 4b.

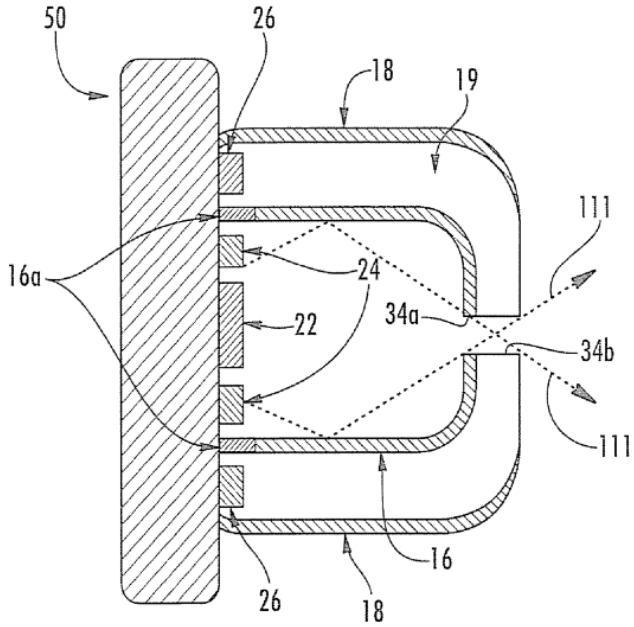
’304 Patent	LeBoeuf
	 FIG. 4A LeBoeuf at Fig. 4a. FIG. 4C illustrates the light-guiding earbud 30 of FIG. 4A modified such that the earbud cover 18 and cladding material 21 are elongated to reach deeper within the ear canal C of a subject, and closer to the tympanic membrane, for example. In the illustrated embodiment of FIG. 4C, apertures 34 a, 34 b in the housing 16 and cover 18 are provided. As such, the optical light-guiding region 19 and the acoustic wave-guiding region 54 are isolated from each other. **The light-guiding region 19 may be a light transmissive material, such as a dielectric material, and the acoustic wave-guiding region 54 may be air or another material, and the separation between these regions may be defined by at least part of the cladding material 21. Embodiments of the present invention may include multiple openings 34 a, 34 b in the housing 16 and cover 18. The separation between the light-guiding region**

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	19 and the acoustic wave-guiding region 54 may be defined by other structures composed of a variety of possible materials. Specific examples of these materials include plastic molding, metals, polymeric structures, composite structures, or the like. LeBoeuf at [0110].  FIG. 4C LeBoeuf at Fig. 4c. FIG. 4D illustrates the light-guiding earbud 30 of FIG. 4A modified such that the earbud cover 18 and cladding material 21 are elongated to reach deeper within the ear canal C of a subject, and closer to the tympanic membrane, for example. In the illustrated embodiment of FIG. 4D, the area within the housing 16 may be air, silicone, plastic, or any material capable of passing sound. **As such, at opening 34 b, an interface exists between the material of the light-guiding region 19 and the material within the housing 16. In some embodiments, the light-guiding region 19 and the region within the housing 16 may both be air. In other embodiments, the light-guiding region 19 and the region within the**

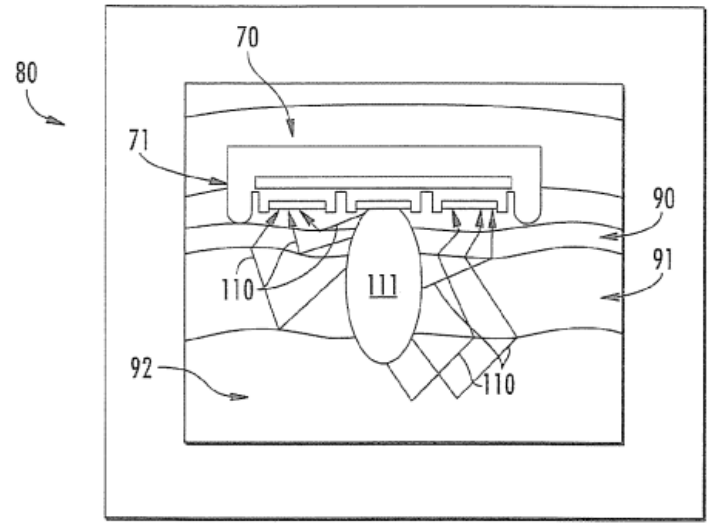
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	housing 16 may be formed from the same or different materials. In some embodiments, the region within the housing 16 may be formed from an optical wave guiding material identical or similar to the material in the light-guiding region 19. LeBoeuf at [0111].  FIG. 4D LeBoeuf at Fig. 4d. **Referring now to FIG. 6, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an earbud housing 16 extending outwardly from the base 50 that is**

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	configured to be positioned within an ear E of a subject, and a cover 18 of light transmissive material surrounding the earbud housing 16 that forms a light-guiding region 19. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the speaker 22 can pass. **The earbud housing 16 encloses the speaker 22, an optical emitter 24 and an optical detector 26 as illustrated. An additional light detector 26 is located on the base 50 but is not surrounded by the earbud housing 16.** LeBoeuf at [0115] The earbud housing 16 is formed of a cladding material. T**he cladding material may be reflective material in some embodiments. In other embodiments, the cladding material may be optically transparent or mostly transparent with a lower index of refraction than the light transmissive material of the cover 18.** In some embodiments, the earbud housing 16 may be replaced by air, such that the cladding region is air. Air may have a smaller index of refraction than that of **the cover 18, supporting light transmission along the cover 18. In other embodiments, a cladding region exists between the earbud housing 16 and the light-guiding region 19. In another embodiment, a cladding region exists covering the outside of light-guiding region 19, with the exception of regions surrounding the lens regions 18L.** LeBoeuf at [0116] In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, **where the flexible optical circuit may include one or more optical emitters** and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. **For example, these flexible devices may include an organic LED (OLED)** and an organic optical detector circuit. LeBoeuf at [0122]

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	Referring now to FIGS. 8A-8B, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an earbud housing 16 extending outwardly from the base 50 that is configured to be positioned within an ear of a subject, and a cover 18 that surrounds the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the speaker 22 can pass. The cover 18 includes at least one aperture 34 b through which sound from the speaker 22 can pass. **The cover 18 includes a cladding material 21 on the outer surface 18 a thereof, except at end portion 18 f, as illustrated. In the illustrated embodiment, there is no cladding material on the cover inner surface 18 b. The housing 16 is in contact with the cover inner surface 18 b and serves as a cladding layer to define the light guiding region 19. The cover 18 with the illustrated cladding material 18 c serves as a light guide that delivers light from the optical emitters 24 into an ear canal of a subject through cover end portion 18 f. The cover 18 also collects light through end portion 18 f and delivers the collected light to the optical detectors 26.** Various configurations and arrangements of optical emitters and detectors may be utilized in accordance with embodiments of the present invention. LeBoeuf at [0123] **In some embodiments, as illustrated in FIG. 8C, the earbud housing 16 may be at least partially reflective to scatter light within the cavity defined by the earbud housing 16. In such case, the optical energy 111 may exit the earbud 30 through apertures 34 a, 34 b in the housing 16 and cover 18. An advantage of this configuration is that light 111 can be focused on a particular region of the ear where a particular physiological activity may be located.** Also, this configuration may reduce unwanted optical signals from regions that may not be relevant to the physiological activity of interest. Although FIG. 8C shows the apertures 34 a, 34 b positioned toward the tympanic membrane, the apertures 34 a, 34 b may be located at one or more other locations about the earbud 30. For example**, an aperture may be formed in the housing 16 and cover 18 at the location where the earbud 30 contacts the antitragus of an ear to allow optical energy 111 to interrogate the antitragus region of the ear.** LeBoeuf at [0125]

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	 FIG. 8C LeBoeuf at Fig. 8c **FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured,** as opposed to measuring transmitted wavelengths. **The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths** 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains **one or more optical sources emitting one or more optical wavelengths,** as well as one or more optical detectors detecting one or more optical wavelengths.

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	LeBoeuf at [0140]  FIG. 19 LeBoeuf at Fig.19 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors	LeBoeuf discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.

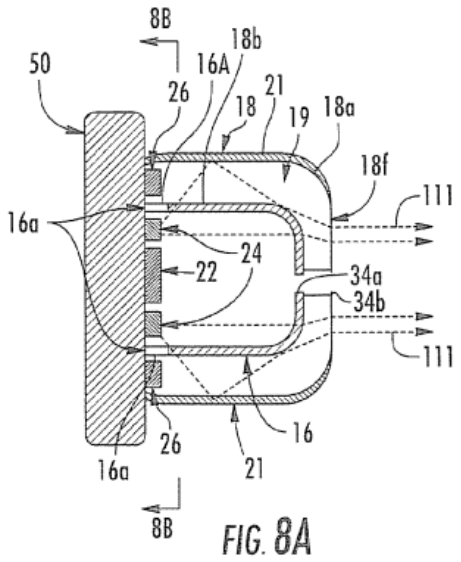
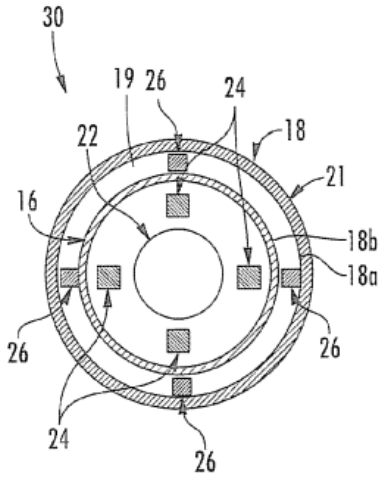
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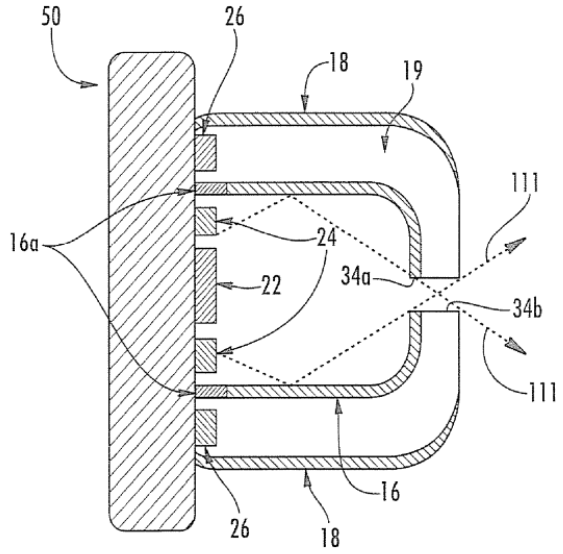
’304 Patent	LeBoeuf
arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	*See* claim 11 above. **According to some embodiments of the present invention, a monitoring device includes a circular band capable of encircling a finger of a subject, and a base having an optical emitter and an optical detector attached to the circular band. The circular band includes light transmissive material in optical communication with the optical emitter and optical detector that is configured to deliver light from the optical emitter to one or more portions of the finger of the subject and to collect light from one or more portions of the finger of the subject and deliver the collected light to the optical detector. In some embodiments, the circular band includes first and second concentric body portions.** In some embodiments, the circular band includes a lens region in optical communication with the optical emitter that focuses light emitted by the optical emitter and/or that collects light reflected from a finger. In some embodiments the circular band includes a phosphor-containing region in optical communication with the light transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. In some embodiments, **the light transmissive material of the circular band** has an outer surface and an inner surface, and a cladding material, such as light reflective material, is on (or near) at least a portion of one or both of the inner and outer surfaces. LeBoeuf at [0030-0032]. **Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD), compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like.** The speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092].

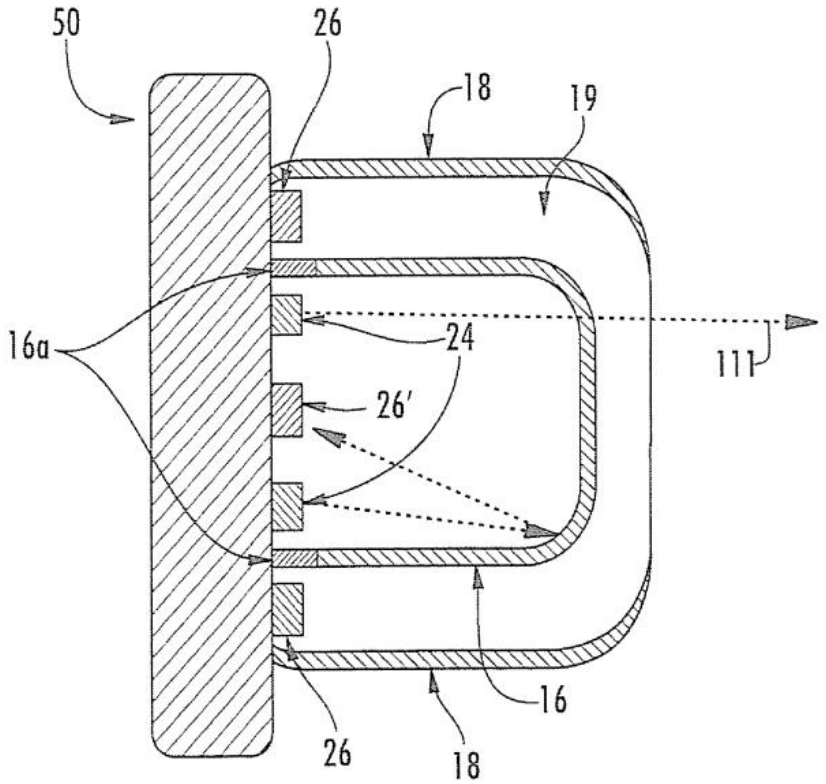
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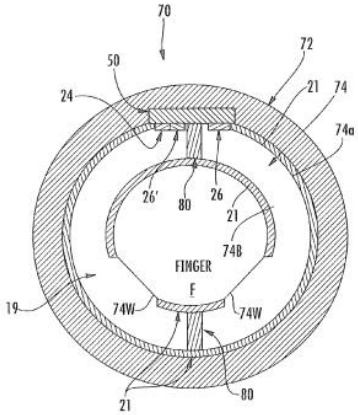
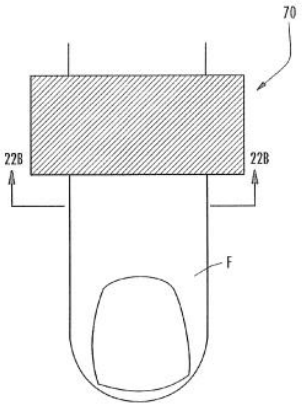
’304 Patent	LeBoeuf
	Referring now to FIGS. 8A-8B, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an earbud housing 16 extending outwardly from the base 50 that is configured to be positioned within an ear of a subject, and a cover 18 that surrounds the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the speaker 22 can pass. The cover 18 includes at least one aperture 34 b through which sound from the speaker 22 can pass. The cover 18 includes a cladding material 21 on the outer surface 18 a thereof, except at end portion 18 f, as illustrated. In the illustrated embodiment, there is no cladding material on the cover inner surface 18 b. **The housing 16 is in contact with the cover inner surface 18 b and serves as a cladding layer to define the light guiding region 19. The cover 18 with the illustrated cladding material 18 c serves as a light guide that delivers light from the optical emitters 24 into an ear canal of a subject through cover end portion 18 f. The cover 18 also collects light through end portion 18 f and delivers the collected light to the optical detectors 26. Various configurations and arrangements of optical emitters and detectors may be utilized in accordance with embodiments of the present invention.** LeBoeuf at [0123].

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	 FIG. 8A  FIG. 8B LeBoeuf at Figs. 8a and 8b.

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	 FIG. 8C LeBoeuf at Fig. 8c.

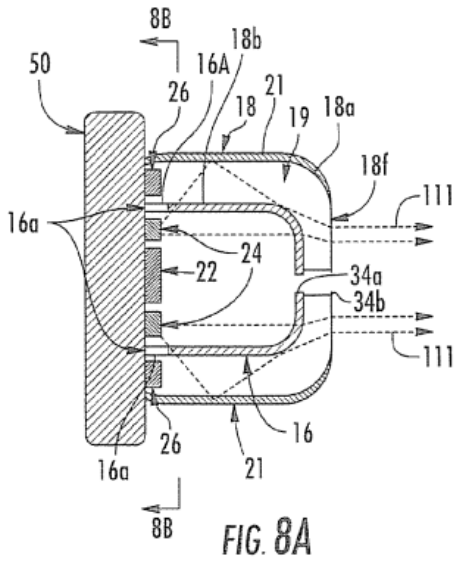
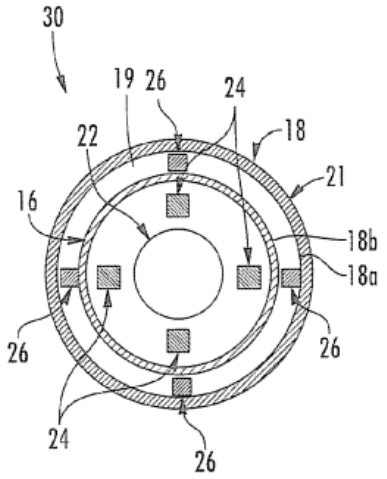
’304 Patent	LeBoeuf
	 FIG. 8D LeBoeuf at Fig. 8d. According to other embodiments of the present invention, monitoring devices with light-guiding regions may be configured to be attached to earlobes, fingers, toes, other digits, etc. **For example, FIGS. 22A-22B illustrate a monitoring device 70 that is configured to fit over a finger F, for example, as a finger ring, according to some embodiments of the present invention. The illustrated monitoring device 70 includes a generally circular band capable of encircling a finger F of a subject, with a**

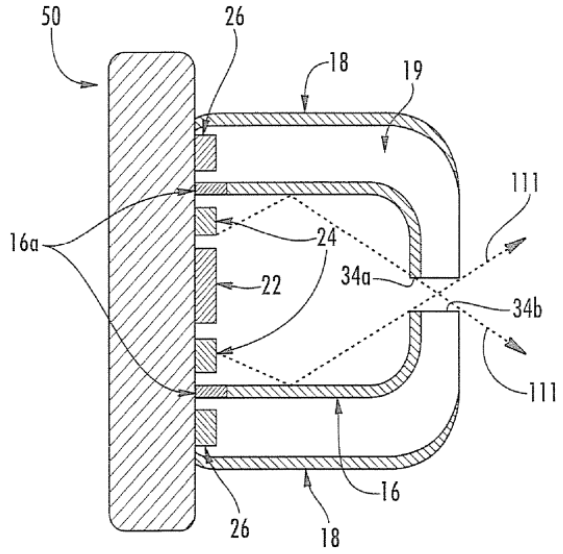
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	cylindrical outer body portion 72 and a generally cylindrical inner body portion 74 secured together in concentric relationship. The outer body portion may be formed from virtually any type of material and may have an ornamental configuration**.** In some embodiments, the outer body portion 72 may include a flex circuit containing various electronic components, such as a microprocessor, D/A converter, power source, power regulator, and the like. However, in some embodiments, the outer body portion 72 may not be required and the circular band of the monitoring device 70 includes only the inner body portion 74 secured to the base 50 (described below). LeBoeuf at [0157]  FIG. 22B  FIG. 22A LeBoeuf at Figs. 22A and 22B. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

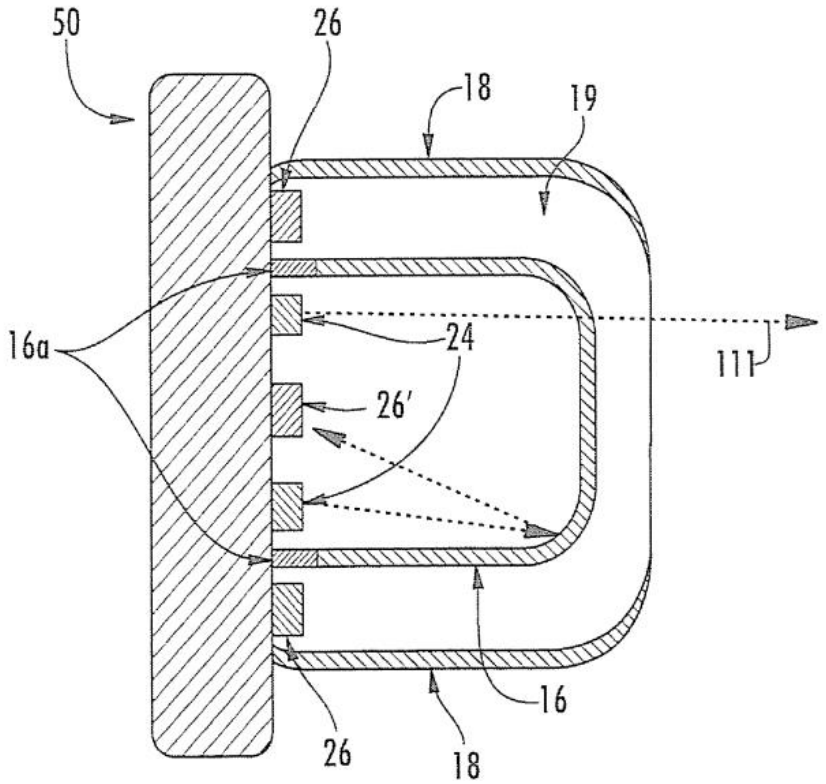
’304 Patent	LeBoeuf
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	LeBoeuf discloses or renders obvious the measurement system of claim 15, wherein the first arc and the second arc are concentric. *See* claim 15 above. **According to some embodiments of the present invention, a monitoring device includes a circular band capable of encircling a finger of a subject, and a base having an optical emitter and an optical detector attached to the circular band. The circular band includes light transmissive material in optical communication with the optical emitter and optical detector that is configured to deliver light from the optical emitter to one or more portions of the finger of the subject and to collect light from one or more portions of the finger of the subject and deliver the collected light to the optical detector. In some embodiments, the circular band includes first and second concentric body portions.** In some embodiments, the circular band includes a lens region in optical communication with the optical emitter that focuses light emitted by the optical emitter and/or that collects light reflected from a finger. In some embodiments the circular band includes a phosphor-containing region in optical communication with the light transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. In some embodiments, **the light transmissive material of the circular band** has an outer surface and an inner surface, and a cladding material, such as light reflective material, is on (or near) at least a portion of one or both of the inner and outer surfaces. LeBoeuf at [0030-0032] **Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD), compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like.** The speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic

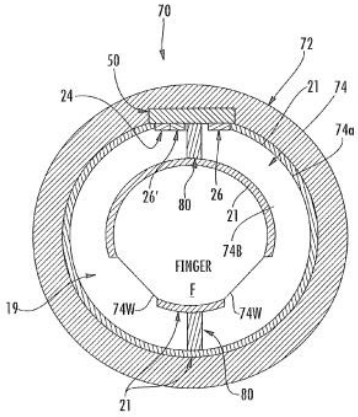
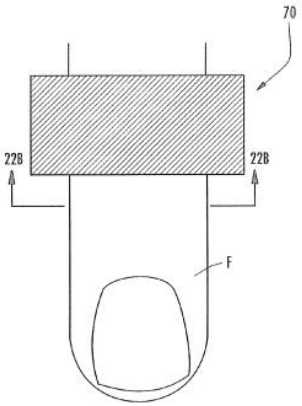
’304 Patent	LeBoeuf
	transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092]. Referring now to FIGS. 8A-8B, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an earbud housing 16 extending outwardly from the base 50 that is configured to be positioned within an ear of a subject, and a cover 18 that surrounds the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the speaker 22 can pass. The cover 18 includes at least one aperture 34 b through which sound from the speaker 22 can pass. The cover 18 includes a cladding material 21 on the outer surface 18 a thereof, except at end portion 18 f, as illustrated. In the illustrated embodiment, there is no cladding material on the cover inner surface 18 b. **The housing 16 is in contact with the cover inner surface 18 b and serves as a cladding layer to define the light guiding region 19. The cover 18 with the illustrated cladding material 18 c serves as a light guide that delivers light from the optical emitters 24 into an ear canal of a subject through cover end portion 18 f. The cover 18 also collects light through end portion 18 f and delivers the collected light to the optical detectors 26. Various configurations and arrangements of optical emitters and detectors may be utilized in accordance with embodiments of the present invention.** LeBoeuf at [0123].

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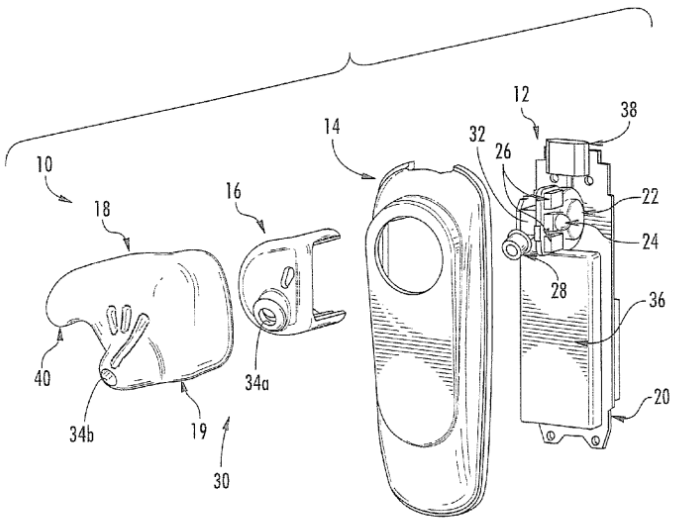
’304 Patent	LeBoeuf
	 FIG. 8A  FIG. 8B LeBoeuf at Figs. 8a and 8b.

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	 FIG. 8C LeBoeuf at Fig. 8c.

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	 FIG. 8D LeBoeuf at Fig. 8d. According to other embodiments of the present invention, monitoring devices with light-guiding regions may be configured to be attached to earlobes, fingers, toes, other digits, etc. **For example, FIGS. 22A-22B illustrate a monitoring device 70 that is configured to fit over a finger F, for example, as a finger ring, according to some embodiments of the present invention. The illustrated monitoring device 70 includes a generally circular band capable of encircling a finger F of a subject, with a**

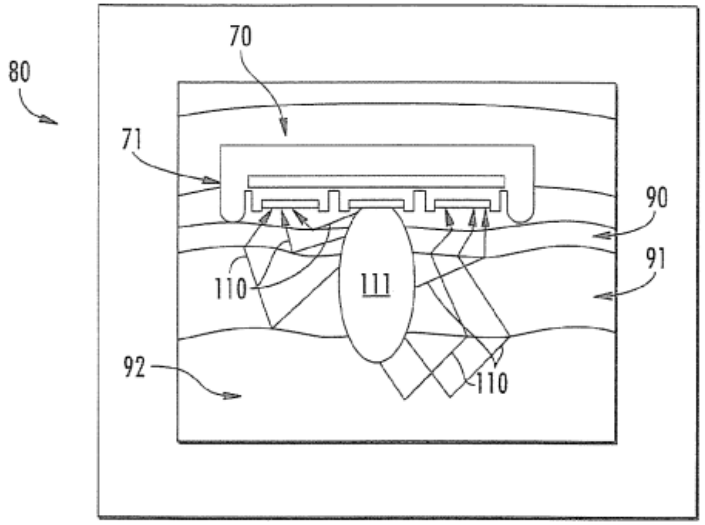
’304 Patent	LeBoeuf
	cylindrical outer body portion 72 and a generally cylindrical inner body portion 74 secured together in concentric relationship. The outer body portion may be formed from virtually any type of material and may have an ornamental configuration**.** In some embodiments, the outer body portion 72 may include a flex circuit containing various electronic components, such as a microprocessor, D/A converter, power source, power regulator, and the like. However, in some embodiments, the outer body portion 72 may not be required and the circular band of the monitoring device 70 includes only the inner body portion 74 secured to the base 50 (described below). LeBoeuf at [0157]  FIG. 22B  FIG. 22A LeBoeuf at Figs. 22A and 22B. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. LeBoeuf discloses or renders obvious a wearable device for use with a smart phone or tablet, the wearable device. *See* 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	LeBoeuf discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources	LeBoeuf discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths.

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having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated **headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16**. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, **optical emitter 24, optical detectors 26,** and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, **optical emitter 24, optical detectors 26,** and thermopile 28. **Collectively, the earbud housing 16, cover 18, and various electronic components (e.g., speaker 22, optical emitter 24, optical detectors 26, thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30.** LeBoeuf at [0091]  FIG. 1 LeBoeuf at Fig. 1. Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. **The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD),** compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The

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	speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092] The illustrated cover 18 of FIG. 1 includes an alignment member 40 (also referred to as a stabilization arm) that facilitates alignment of the earbud 30 within an ear canal of a subject. **The alignment member 40 may facilitate stable measurements of optical scattered light from the ear region, which can be important for PPG measurements and tympanic temperature measurements.** LeBoeuf at [0099] In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, **where the flexible optical circuit may include one or more optical emitters** and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. **For example, these flexible devices may include an organic LED (OLED)** and an organic optical detector circuit. LeBoeuf at [0122] FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring transmitted wavelengths. **The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths** 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains **one**

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	or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140]  FIG. 19 LeBoeuf at Fig.19 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	LeBoeuf discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;	LeBoeuf discloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue; *See* 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	LeBoeuf discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d].

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	LeBoeuf discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	LeBoeuf discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[a], 11[b], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	LeBoeuf discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	LeBoeuf discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* claim 11[k], 19[pre] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and	LeBoeuf discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal and transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre].

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transmit at least a portion of the processed output signal over a wireless transmission link.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	LeBoeuf discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claims 19, 13 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	LeBoeuf discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claims 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	LeBoeuf discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claims 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D8

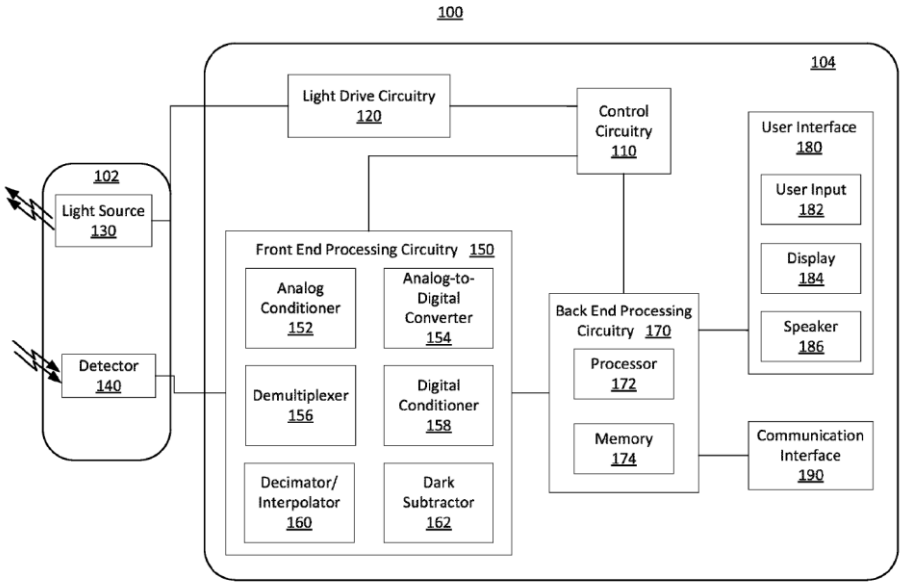
U.S. Pat. No. 10,874,304 in view of U.S. Patent No. 9.241,676 to Lisogurski et al. ("Lisogurski")

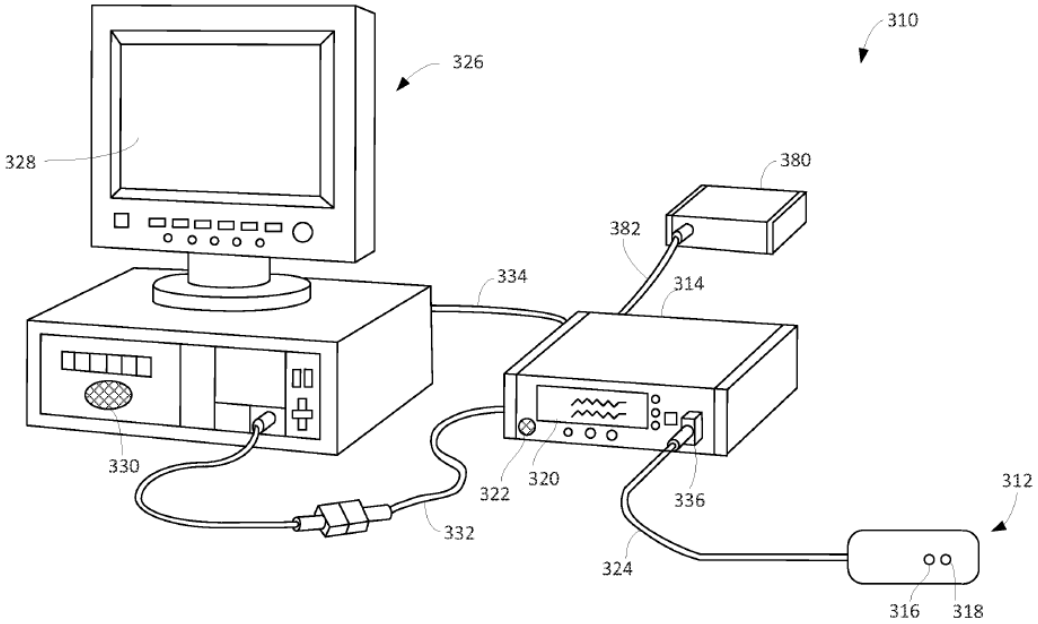
As described in detail below, Lisogurski (individually or collectively) anticipates and/or renders obvious claims 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D7 and D9-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Lisogurski. The cited portions of Lisogurski are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Lisogurski. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Lisogurski "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Lisogurski does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Lisogurski (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Lisogurski anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 1	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lisogurski discloses or renders obvious a measurement system.  FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 3 Lisogurski at Fig. 3. A physiological monitoring system may use photonic signals to determine physiological parameters. The system may vary parameters of a light drive signal used to generate the photonic signal from a light source such that power consumption is reduced or optimized. Parameters may include light intensity, firing rate, duty cycle, other suitable parameters, or any combination thereof. In some embodiments, the system may use information from a first light source to generate a light drive signal for a second light source. In some embodiments, the system may vary parameters in a way substantially synchronous with physiological pulses, for example, cardiac pulses. In some embodiments, the system may vary parameters in response to an external trigger. Lisogurski at [Abstract].

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	Systems and methods are provided for optimizing power consumption in an optical physiological monitoring system. The system may vary light drive signal parameters to reduce power consumption or vary power use. The system may vary parameters in a technique correlated to cardiac pulse cycles. In some embodiments, reducing power consumption may allow for increased battery life in portable systems or increased portability. In some embodiments, varying light output during a cardiac cycle may reduce heating effects of the emitters. Parameters that may be varied include light intensity, firing rate, duty cycle, other suitable parameters, or any combination thereof. The generated signals may be used to determined physiological parameters such as blood oxygen saturation, hemoglobin, blood pressure, pulse rate, other suitable parameters, or any combination thereof. In some embodiments, the system may use information from a first light source to control a second light source. The system may generate a first light drive signal for activating a first light source to emit a first photonic signal. The first light source and second light source may each include one or more emitters. The system may receive a light signal attenuated by the subject, wherein the light signal comprises a component corresponding to the first photonic signal. The system may analyze the component of the light signal to determine when to activate a second light source. The system may generate a second light drive signal, based on the analysis of the first component, for activating the second light source to emit one or more second photonic signals. The system may determine one or more physiological parameters based on the light signals. In some embodiments, the system may vary a light drive signal in a way substantially synchronous with physiological pulses, for example, cardiac pulses. The system may generate a light drive signal for activating a light source to emit a photonic signal, wherein at least one parameter of the light drive signal is configured to vary substantially synchronously with physiological pulses of the subject. The system may receive a light signal attenuated by the subject, wherein the signal comprises a component corresponding to the emitted photonic signal. The system may determine physiological parameters based on the signal. In some embodiments, the system may vary light levels with other periodic (or mostly periodic) physiological changes. For example, venous return changes with intrathoracic pressure during a respiration cycle can affect the baseline level of the photoplethysmography waveform. The system may vary the emitter output such that similar signal quality is available at the detector over time varying volumes of venous blood present in the path of light. In some embodiments, the system may vary a light drive signal based on a received external trigger. The system may receive an external trigger based on a signal other than a light signal received by the

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	physiological monitor. The trigger may include a signal received from an ECG sensor, an ECG sensor configured to detect an R-wave, a blood pressure sensor, a respiration rate sensor, any other suitable sensor, or any combination thereof. The system may, in response to the external trigger, vary the light intensity, duty cycle, light source firing rate, any other Suitable parameter, or any combination thereof. Lisogurski at 1:10-2:3. The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. The system may include, for example, a light source and a photosensitive detector. Providing a light drive signal to the light source may account for a significant portion of the systems total power consumption. Thus, it may be desirable to reduce the power consumption of the light source, while still enabling high quality physiological parameters to be determined. The system may reduce the power consumption by modulating parameters associated with the light drive signal in techniques correlated to the cardiac cycle or other cyclical physiological activity. For example, the system may decrease brightness during a particular portion of the cardiac cycle. It may also be desirable to reduce the power consumption by the light drive signal to reduce heating effects caused by an emitter. An oximeter is a medical device that may determine the oxygen saturation of an analyzed tissue. One common type of oximeter is a pulse oximeter, which may non-invasively measure the oxygen saturation of a patient’s blood (as opposed to measuring oxygen saturation directly by analyzing a blood sample taken from the patient). Pulse oximeters may be included in patient monitoring systems that measure and display various blood flow characteristics including, but not limited to, the oxygen Saturation of hemoglobin in arterial blood. Such patient monitoring systems may also measure and display additional physiological parameters. Such as a patient’s pulse rate and blood pressure. An oximeter may include a light sensor that is placed at a site on a patient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot. The oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically under stood to be optimal for pulse oximetry serve as suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional Suitable sensor locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patients thigh to monitor femoral artery pulsatile flow,

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	the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. In all suitable locations, for example, the oximeter may measure the intensity of light that is received at the light sensor as a function of time. Lisogurski at 3:43-4:25. The system may process data to determine physiological parameters using techniques well known in the art. For example, the system may determine blood oxygen saturation using two wavelengths of light and a ratio-of-ratios calculation. The system also may identify pulses and determine pulse amplitude, respiration, blood pressure, other suitable parameters, or any combination thereof, using any suitable calculation techniques. In some embodiments, the system may use information from external sources (e.g., tabulated data, secondary sensor devices) to determine physiological parameters. In some embodiments, it may be desirable to implement techniques to optimize power consumption in an oximeter or other system. For example, in a battery powered system, reducing the power requirements may allow for smaller devices, longer life, or both. In some embodiments, powering the light source may include a large amount of the power load a device may experience. In some embodiments, variation of parameters in the light drive signal may enable a particular amount of power to be used more efficiently. For example, the brightness of a light source may be decreased during a less important period and increased during a more important period. In some embodiments, parameter variation may reduce the impact of heating effects caused by a light source on a subject. Techniques to vary the amount of time a light Source is turned on, to vary the brightness of the light source, other techniques, or any combination thereof, may be employed to modify power consumption. Lisogurski at 4:52-5:12 FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Lisogurski at 10:42-47.

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	In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subjects tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. In the embodiment shown, monitor 104 includes control circuitry 110, light drive circuitry 120, front end processing circuitry 150, back end processing circuitry 170, user interface 180, and communication interface 190. Monitor 104 may be communicatively coupled to sensor 102. Lisogurski at 11:9-32. Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. Lisogurski at 12:42-45. Back end processing circuitry 170 may include processor 172 and memory 174. Processor 172 may be adapted to execute software, which may include an operating system and one or more applications, as part of performing the functions described herein. Processor 172 may receive and process physiological signals received from front end processing circuitry 150. For example, processor 172 may determine one or more physiological parameters based on the received physiological signals. Memory 174 may include any suitable computer-readable media capable of storing information that can be interpreted by processor 172. Lisogurski at 14:56-66.

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	User interface 180 may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device. Lisogurski at 15:19-23. Additionally, display 184 may display, 30 for example, an estimate of a subject's blood oxygen saturation generated by monitor 104 (referred to as an "SpO2 " measurement), pulse rate information, respiration rate information, blood pressure, any other parameters, and any combination thereof. Lisogurski at 15:30-35. Communication interface 190 may enable monitor 104 to exchange information with external devices. Communications interface 190 may include any suitable hardware, software, or both, which may allow monitor 104 to communicate with electronic circuitry, a device, a network, a server or other workstations, a display, or any combination thereof. Communications interface 190 may include one or more receivers, transmitters, transceivers, antennas, plug-in connectors, ports, communications buses, communications protocols, device identification protocols, any other suitable hardware or software, or any combination thereof. Communications interface 190 may be configured to allow wired communication (e.g., using USB, RS-232 or other standards), wireless communication (e.g., using WiFi, IR, WiMax, BLUETOOTH, UWB, or other standards), or both. For example, communications interface 190 may be configured using a universal serial bus (USB) protocol (e.g., USB 2.0, USB 3.0), and may be configured to couple to other devices (e.g., remote memory devices storing templates) using a four-pin USB standard Type-A connector (e.g., plug and/or socket) and cable. In some embodiments, communications interface 190 may include an internal bus such as, for example, one or more slots for insertion of expansion cards. It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as Such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be

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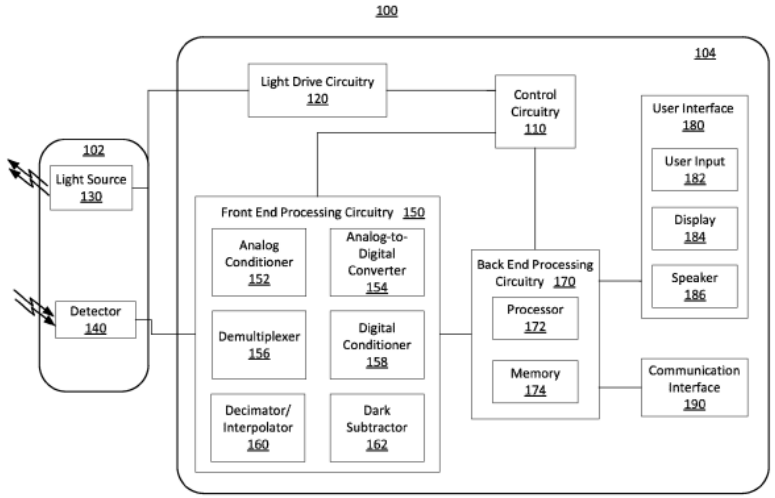
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	required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Lisogurski at 15:43-16:16. FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of anoximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subjects tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the Subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. System 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two different locations on a subjects body. In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. Lisogurski at 17:30-59. Multi-parameter physiological monitor 326 may be configured to calculate physiological parameters and to provide a display 328 for information from monitor 314 and from other medical monitoring devices or systems (not shown). For example, multi-parameter physiological monitor 326 may be configured to display an estimate of a subject's blood oxygen saturation and hemoglobin concentration generated by monitor 314. Multi-parameter physiological monitor 326 may include a speaker 330. Monitor 314 may be communicatively coupled to multiparameter physiological monitor 326 via a cable 332 or 334 that is coupled to a sensor input port or a digital communications port, respectively and/or may communicate wirelessly (not shown). In addition, monitor 314 and/or multi-parameter

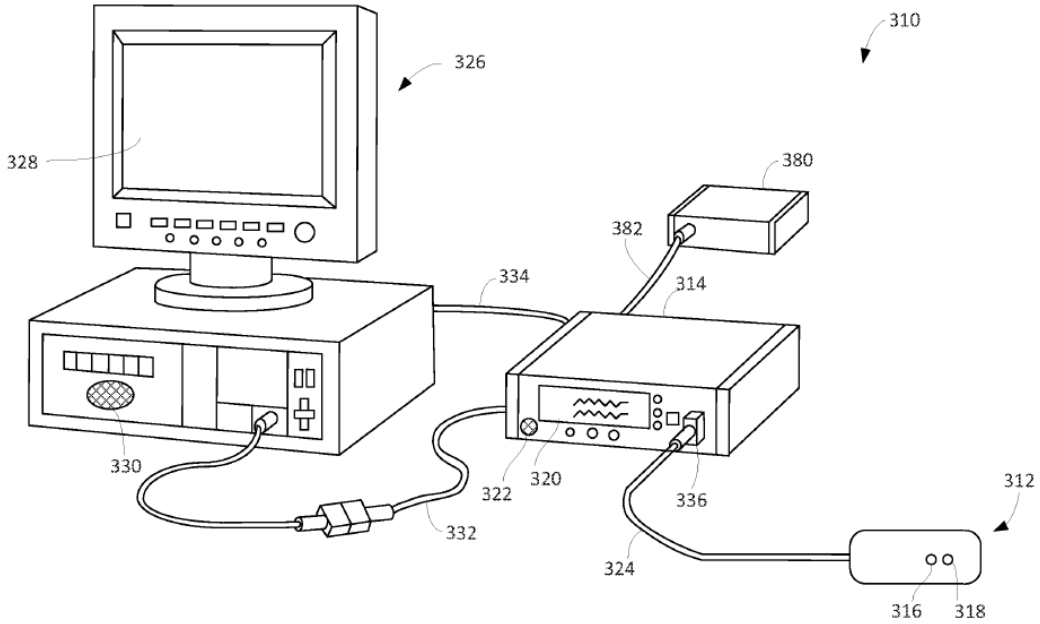
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	physiological monitor 326 may be coupled to a network to enable the sharing of information with servers or other work-stations (not shown). Monitor 314 may be powered by a battery (not shown) or by a conventional power source such as a wall outlet. Lisogurski at 18:49-66. The system may display the determined physiological parameter using a local display (e.g., display 320 of FIG. 3 or display 328 of FIG. 3), display them on a remote display, publish the data to a server or website, make the parameters available to a user by any other suitable technique, or any combination thereof. Lisogurski at 20:55-60. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Lisogurski discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths.

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	 FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 3 Lisogurski at Fig. 3. Systems and methods are provided for optimizing power consumption in an optical physiological monitoring system. The system may vary light drive signal parameters to reduce power consumption or vary power use. The system may vary parameters in a technique correlated to cardiac pulse cycles. In some embodiments, reducing power consumption may allow for increased battery life in portable systems or increased portability. In some embodiments, varying light output during a cardiac cycle may reduce heating effects of the emitters. Parameters that may be varied include light intensity, firing rate, duty cycle, other suitable parameters, or any combination thereof. The generated signals may be used to determined physiological parameters such as blood oxygen saturation, hemoglobin, blood pressure, pulse rate, other suitable parameters, or any combination thereof. In some embodiments, the system may use information from a first light source to control a second light source. The system may generate a first light drive signal for activating a first light source to emit a first photonic signal. The first light source and second light source may each include one or more emitters.

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	The system may receive a light signal attenuated by the subject, wherein the light signal comprises a component corresponding to the first photonic signal. The system may analyze the component of the light signal to determine when to activate a second light source. The system may generate a second light drive signal, based on the analysis of the first component, for activating the second light source to emit one or more second photonic signals. The system may determine one or more physiological parameters based on the light signals. Lisogurski at 1:10-41. The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. The system may include, for example, a light source and a photosensitive detector. Providing a light drive signal to the light source may account for a significant portion of the system's total power consumption. Thus, it may be desirable to reduce the power consumption of the light source, while still enabling high quality physiological parameters to be determined. The system may reduce the power consumption by modulating parameters associated with the light drive signal in techniques correlated to the cardiac cycle or other cyclical physiological activity. For example, the system may decrease brightness during a particular portion of the cardiac cycle. It may also be desirable to reduce the power consumption by the light drive signal to reduce heating effects caused by an emitter. An oximeter is a medical device that may determine the oxygen saturation of an analyzed tissue. One common type of oximeter is a pulse oximeter, which may non-invasively measure the oxygen saturation of a patient’s blood (as opposed to measuring oxygen Saturation directly by analyzing a blood sample taken from the patient). Pulse oximeters may be included in patient monitoring systems that measure and display various blood flow characteristics including, but not limited to, the oxygen saturation of hemoglobin in arterial blood. Such patient monitoring systems may also measure and display additional physiological parameters. Such as a patient’s pulse rate and blood pressure. An oximeter may include a light sensor that is placed at a site on a patient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot. The Oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically under stood to be optimal for pulse oximetry serve as Suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional Suitable sensor

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	locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patients thigh to monitor femoral artery pulsatile flow, the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. Suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. In all suitable locations, for example, the oximeter may measure the intensity of light that is received at the light sensor as a function of time. The oximeter may also include sensors at multiple locations. A signal representing light intensity versus time or a mathematical manipulation of this signal (e.g., a scaled version thereof: a logarithm taken thereof, a scaled version of a logarithm taken thereof; a derivative taken thereof, a difference taken thereof, etc.) may be referred to as the photoplethysmograph (PPG) signal. In addition, the term “PPG signal” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue), a transmission signal (i.e., representing the amount of light received from the tissue), any Suitable mathematical manipulation thereof; or any combination thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs. In some applications, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Red and infrared (IR) wave lengths may be used because it has been observed that highly oxygenated blood will absorb relatively less red light and more IR light than blood with a lower oxygen saturation. By comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen Saturation of hemoglobin in arterial blood. The system may process data to determine physiological parameters using techniques well known in the art. For example, the system may determine blood oxygen saturation using two wavelengths of light and a ratio-of-ratios calculation. The system also may identify pulses and determine pulse amplitude, respiration, blood pressure, other suitable parameters, or any combination thereof, using any suitable calculation techniques. In some embodiments, the system may use information from external sources (e.g., tabulated data, secondary sensor devices) to determine physiological parameters. In some embodiments, it may be desirable to implement techniques to optimize power consumption in an oximeter or other system. For example, in a battery powered system, reducing the power requirements may allow for smaller devices, longer life, or both. In some embodiments, powering the light source may include a large amount of the power load a device may experience. In some embodiments, variation of

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	parameters in the light drive signal may enable a particular amount of power to be used more efficiently. For example, the brightness of a light source may be decreased during a less important period and increased during a more important period. In some embodiments, parameter variation may reduce the impact of heating effects caused by a light source on a subject. Techniques to vary the amount of time a light source is turned on, to vary the brightness of the light source, other techniques, or any combination thereof, may be employed to modify power consumption. In some embodiments, the brightness of one of more light sources may be modulated in a technique that is related to the cardiac cycle. The cardiac cycle is the substantially periodic repetition of events that occur, for example, during heart beats. The cardiac cycle may include a systole period and diastole period. The cardiac cycle may include pressure changes in the ventricles, pressure changes in the atria, volume changes in the ventricles, volume changes in the atria, opening and closing of heart valves, heart sounds, and other cyclic events. In some embodiments, the heart may enter a non-periodic state, for example, in certain types of arrhythmia and fibrillation. Lisogurski at 3:43-5:24. In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a "dark" period, followed by a second light source, followed by a "dark" period. The system may measure the ambient light detected by the detector during the "dark" period and then subtract this ambient contribution from the signals received during the first and second "on" periods. In some embodiments, drive cycle modulation may be implemented using time division multiplexing as described above, code division multiplexing, carrier frequency multiplexing, phase division multiplexing, feedback circuitry, DC restoration circuitry, any other suitable technique, or any combination thereof. For example, the system may use frequency division multiplexing in a drive cycle modulation technique. The cardiac cycle modulation may represent a lower frequency envelope function on the higher frequency drive cycle. For example, cardiac cycle modulation may be an envelope on the order of 1 Hz superimposed on a 1 kHz sine wave drive cycle modulation. In some embodiments, the system may use various cardiac cycle modulation schemes to adjust the brightness of a light source controlled by the light drive signal used in determining physiological

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	parameters. The system may modulate the brightness of the light source using a periodic waveform, for example, a sinusoidal or triangle wave. The period of the waveform may be substantially related to the cardiac pulse rate, for example, in a one-to-one relationship, a two-to-one relationship, any other suitable relationship, or any suitable combination thereof. The system may align the peak of the modulated light drive signal with a particular point in the cardiac cycle to improve the quality of the determined physiological parameter, for example, it may be aligned with the diastolic period, the systolic period, the dicrotic notch, any other suitable point, or any combination thereof. In some embodiments, the system may modulate the light drive signal with a square wave function, such that it is at a low brightness level during a first part of the cardiac cycle and a high brightness level during a second part of the cardiac cycle. In some embodiments, the low brightness level may include turning one or more light sources off. Lisogurski at 6:7-52. In some embodiments of cardiac cycle modulation, the system may modulate multiple light sources using a plurality of modulation techniques. For example, in a system with two light sources, the system may operate a first light source at full or regular brightness, while operating one or more additional light sources in a switched or otherwise modulated mode. In some embodiments, the system may operate a first light source according to a first cardiac cycle modulation technique and a second light source according to a second cardiac modulation technique. The first and second cardiac cycle modulation techniques may be the same, correlated, or unrelated. In some embodiments, the system may use the first light source to determine periods of interest in the cardiac cycle. The system may, according to the periods of interest, power additional light sources, alter the modulation of the additional light sources, perform other suitable power optimization techniques, or any combination thereof. In some embodiments, the system may include a first light source (e.g., a light source powered at full or regular brightness) of a type that is a more efficient light source than the one or more additional light sources. For example, the first light source may be a high efficiency infrared (IR) LED while the one or more additional light sources may be lower efficiency red LEDs or laser diodes. In some embodiments, the first light source may be selected based on efficiency parameters and information from the first light source may be used only to control a second light source. For example, a highly efficient first light source that is not at a wavelength of interest for physiological parameter determination may be used to control one or more second light sources at wavelengths of interest. In this case, the light from the first light source may be used only for controlling the second light source and not for determining physiological parameters.

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	In some embodiments, the system may use the first light source to determine a pulse rate or identify elements of the cardiac cycle, and the system may use the pulse rate or identified elements in part to control modulation of the light drive signal. Identified elements may include peaks, valleys, troughs, notches, fiducial points, other suitable elements, or any combination thereof. Fiducial points may be related to the zero crossings of first and higher order derivatives of the waveform. In some embodiments, the system may modulate the first light drive signal according to a first cardiac cycle modulation technique and may modulate the one or more additional light drive signal according to a second cardiac cycle modulation technique. For example, the system may operate the first light source at full or regular brightness for a first “on” period, and then “off” for a second period. The system may use the first “on” period to adjust or calibrate a second modulation technique. The system may implement the second modulation technique for the “off” period, using, for example, one or more light sources that may or may not include the first light source. As described above, this cardiac cycle modulation may be implemented in addition to a drive cycle modulation, conventional servo algorithms, or any combination thereof. Lisogurski at 7:38-8:26. FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light.

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	It will be understood that, as used herein, the term “light” may refer to energy produced by radiative sources and may include one or more of ultrasound, radio, microwave, millimeter wave, infrared, visible, ultraviolet, gamma ray or X-ray electromagnetic radiation. As used herein, light may also include any wavelength within the radio, microwave, infrared, visible, ultraviolet, or X-ray spectra, and that any suitable wavelength of electromagnetic radiation may be appropriate for use with the present techniques. Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130. Lisogurski at 10:42-11:8. Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Light drive circuitry 120, as discussed above, may be configured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of when light source 130 is turned on and off. When light source 130 is configured to emit two or more wavelengths of light, the light drive signal may be configured to control the operation of each wavelength of light. The light drive signal may comprise a single signal or may comprise multiple signals (e.g., one signal for each wavelength of light). An illustrative light drive signal is shown in FIG. 2A. FIG. 2A shows an illustrative plot of a light drive signal including red light “on” period 202 and IR light “on period” 204 in accordance with some embodiments of the present disclosure. Light “on” periods 202, and 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, “on” and “off” may refer to switching power or other components, high and low output states, high and low values within a continuous modulation, high and low duty cycles, other suitable

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	relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red “on” period 202 and IR “on” period 204 to drive red and IR light emitters, respectively, within light source 130. Red “on” period 202 may have a higher amplitude than IR “on” period 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue at certain oxygen saturations. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary, and that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. The light drive signal of FIG. 2A may also include “off” periods 220 between the Red and IR light “on” periods. “Off” periods 220 are periods during which no drive current may be applied to light source 130. “Off” periods 220 may be provided, for example, to prevent overlap of the emitted light, since light source 130 may require time to turn completely on and completely off. The period from time 216 to time 218 may be referred to as a drive cycle, which includes four segments: a Red light “on” periods 202, followed by an “off” period 220, followed by an IR light “on” period 204, and followed by an “off” period 220. After time 218 the drive cycle may be repeated (e.g., as long as a light drive signal is provided to light source 130). It will be understood that the starting point of the drive cycle is merely illustrative and that the drive cycle can start at any location within FIG. 2A, provided the cycle spans two light “on” periods and two “off” periods. Thus, each Red light “on” period 202 and each IR “on” period 204 may be understood to be surrounded by two dark periods 220. Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may

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	represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below Lisogurski at 11:33-13:6. Ideally, when ambient light is zero and when the light source is off, the analog-to-digital converter 154 will read just above the minimum input value. When the light source is on, the total analog gain may be set such that the output of analog-to-digital converter 154 may read close to the full scale of analog-to-digital converter 154 without saturating. This may allow the full dynamic range of analog-to-digital converter 154 to be used for representing the detection signal, thereby increasing the resolution of the converted signal. In some embodiments, the total analog gain may be reduced by a small amount so that small changes in the light level incident on the detector do not cause saturation of analog-to-digital converter 154. However, if the contribution of ambient light is large relative to the contribution of light from a light source, the total analog gain applied to the detection current may need to be reduced to avoid saturating analog-to-digital converter 154. When the analog gain is reduced, the portion of the signal corresponding to the light source may map to a smaller number of analog-to-digital conversion bits. Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Lisogurski at 14:27-55.

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	Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. System 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two different locations on a subjects body. In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Lisogurski at 17:37-59. In some embodiments, sensor unit 312 may be communicatively coupled to monitor 314 via a cable 324. Cable 324 may include electronic conductors (e.g., wires for transmitting electronic signals from detector 318), optical fibers (e.g., multi-mode or single-mode fibers for transmitting emitted light from light source 316), any other suitable components, any suitable insulation or sheathing, or any combination thereof. In some embodiments, a wireless transmission device (not shown) or the like may be used instead of or in addition to cable 324. Monitor 314 may include a sensor interface configured to receive physiological signals from sensor unit 312, provide signals and power to sensor unit 312, or otherwise communicate with sensor unit 312. The sensor interface may include any suitable hardware, software, or both, which may be allow communication between monitor 314 and sensor unit 312. Lisogurski at 18:16-31. In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130

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	of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulation. For example, the first light drive signal may be configured to activate one LED to emit a photonic signal and not activate other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated. Lisogurski at 19:20-39. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Lisogurski discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. *See* 11[a]. Parameters that may be varied include light intensity, firing rate, duty cycle, other suitable parameters, or any combination thereof. Lisogurski at 1:19-21. The system may generate a light drive signal for activating a light source to emit a photonic signal, wherein at least one parameter of the light drive signal is configured to vary substantially synchronously with physiological pulses of the subject.

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	Lisogurski at 1:44-48. The system may, in response to the external trigger, vary the light intensity, duty cycle, light source firing rate, any other suitable parameter, or any combination thereof. Lisogurski at 1:67-2:3. In some applications, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Lisogurski at 4:42-45. As used herein, “drive cycle modulation” (described below) will refer to a relatively higher frequency modulation technique that the system may use to generate one or more wavelengths of intensity signals. Cardiac cycle modulation may have a period of, for example, around 1 second, while drive cycle modulation may have a period around, for example, 1.6 milliseconds. In some embodiments, conventional servo algorithms may be used in addition to any combination of cardiac cycle modulation and drive cycle modulation. Conventional servo algorithms may adjust the light drive signals due to, for example, ambient light changes, emitter and detector spacing changes, sensor positioning, other suitable parameters, or any combination thereof. Generally, conventional servo algorithms vary parameters at a slower rate than cardiac cycle modulation. For example, a conventional servo algorithm may adjust drive signal brightness due to ambient light every several seconds. The system may use conventional servo algorithms in part to keep received signal levels within the range of an analog to digital converter's dynamic range. For example, a signal with amplitudes that are large may saturate an analog to digital convertor. In response to a signal with high amplitudes, the system may reduce emitter brightness. In a further example, the quality of a low amplitude signal may be degraded by quantization noise by an analog to digital converter. In response, the system may increase the emitter brightness. Lisogurski at 5:48-6:6.

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	In some embodiments of cardiac cycle modulation, the system may modulate multiple light sources using a plurality of modulation techniques. For example, in a system with two light sources, the system may operate a first light source at full or regular brightness, while operating one or more additional light sources in a switched or otherwise modulated mode. In some embodiments, the system may operate a first light source according to a first cardiac cycle modulation technique and a second light source according to a second cardiac modulation technique. The first and second cardiac cycle modulation techniques may be the same, correlated, or unrelated. In some embodiments, the system may use the first light source to determine periods of interest in the cardiac cycle. The system may, according to the periods of interest, power additional light sources, alter the modulation of the additional light sources, perform other suitable power optimization techniques, or any combination thereof. In some embodiments, the system may include a first light source (e.g., a light source powered at full or regular brightness) of a type that is a more efficient light source than the one or more additional light sources. For example, the first light source may be a high efficiency infrared (IR) LED while the one or more additional light sources may be lower efficiency red LEDs or laser diodes. In some embodiments, the first light source may be selected based on efficiency parameters and information from the first light Source may be used only to control a second light source. For example, a highly efficient first light source that is not at a wavelength of interest for physiological parameter determination may be used to control one or more second light sources at wavelengths of interest. In this case, the light from the first light source may be used only for controlling the second light source and not for determining physiological parameters. Lisogurski at 7:38-8:3. In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other suitable reasons, or any combination thereof. The system may receive, for example, an increased level of background noise in the signal due to patient motion. The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio. In some embodiments, the system may increase brightness throughout the cardiac cycle because the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion. In some embodiments, the system may change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light.

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	Lisogurski at 9:46-60. Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subjects tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a Subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Lisogurski at 10:48-64. For example, light drive circuitry 120 may generate a light drive signal, which may be used to tum on and off the light source 130, based on the timing control signals. Lisogurski at 11:38-41. Light drive circuitry 120, as discussed above, may be configured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of when light source 130 is turned on and off. Lisogurski at 11:50-54. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Lisogurski at 14:49-55.

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	Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subjects tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Lisogurski at 17:37-45. In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wave lengths, any other Suitable arrangement, or any combination thereof. Lisogurski at 19:20-31. In step 404, the system may receive a light signal. The light may be received using a sensor, for example, detector 140 of FIG. 1 or detector 318 of FIG. 3. The light signal may be attenuated by the subject. The received light signal may in part include light from the first photonic signal. For example, the system may emit light that is reflected by the subject or transmitted through the subject. The interaction of the emitted light with the subject may cause the light to become attenuated. In some embodiments, the attenuation of the light may depend on the wavelength of the light and the tissue with which the light interacts. For example, particular wavelengths of light may be attenuated more strongly by oxyhemoglobin than other wavelengths. In some embodiments, the system may amplify the received signal using front end processor circuitry. In some embodiments, the gain may be modulated using a technique correlated to the cardiac cycle modulation. The gain of the amplifier may be adjusted based on the emitted light brightness, historical information related to the brightness of prior received attenuated signals, other suitable information, or any combination thereof, so that the amplified signal matches the range of the analog-to-digital converter and thus increases resolution. In some embodiments, the system may account for the gain using hardware, software, or any combination thereof, such that the original intensity information is retained.

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	Lisogurski at 19:40-64. For example, the system may generate a light drive signal that varies with a period the same as or closely related to the period of the cardiac cycle, thus generating a cardiac cycle modulation. The system may vary parameters related to the light drive signal including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof. Lisogurski at 25:49-55. The system may vary the light drive signal in a way correlated to the cardiac pulse signal of the subject. The system may generate an "on" light drive signal during one or more cardiac cycles and an "off' light drive signal during one or more cardiac cycles. For example, the system may generate an "on" light drive signal during period 1420 concurrent with pulse cycle 1406, an "off' light drive signal during pulse cycles 1408 and 1410, an "on" light drive signal during period 1422 concurrent with pulse cycle 1412, an "off' light drive signal during pulse cycles 1414 and 1416, and an "on" light drive signal during period 1424 concurrent with pulse cycle 1418. It will be understood that this particular modulation is merely exemplary and that any suitable inter-cycle modulation may be used. Lisogurski at 31:11-24. The system may determine the timing of the cardiac cycles using historical information from previous cardiac cycles, from an external sensor, from user input, from measurements made with a different cardiac cycle modulation, by any other suitable technique, or any combination thereof. It will be understood that the system may align modulation with pulses of the heart, pulses of a particular muscle group, other suitable pulses, any other suitable physiological function, or any combination thereof. It will also be understood that modulation of the light drive signal (i.e., the "on" and "off' states illustrated by light drive signal 1110) is merely exemplary and may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof. It will also be understood that the "on" and "off' states are merely exemplary and that the system may use any suitable number of discrete or continuous modulation variations. Lisogurski at 31:39-55.

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	It will also be understood that sampling rate is one of the components that may be modulated in cardiac cycle modulation as described above. It will also be understood that the earlier described embodiments relating to varying light output may also apply to sampling rate. Lisogurski at 35:5-9. In some embodiments, the system may detect a condition where a second mode is required that is not related to a physiological condition. For example, the system may detect a change in background noise, a change in ambient light, a change in the available power, other suitable changes, or any combination thereof. In some embodiments, an increase in the number ofidentified fiducial points (e.g., zero crossings of the derivatives) may cause the system to vary drive signals. In step 1906, the system may perform a physiological measurement in a second mode. For example, the system may stop cardiac cycle modulation and emit light at a constant brightness. In a further example, the system may increase the emitter intensity used in a cardiac cycle modulation. In a further example, the system may lengthen the "on" periods of a cardiac cycle modulation. In a further example, the system may alter the cardiac cycle modulation technique as described above with relation to FIG. 8B. Lisogurski at 37:6-22. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Lisogurski discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. *See* 11[a]. In some embodiments, the system may correct for non-linearity of light sources. For example, the emitted intensity of light from an LED may not vary linearly with the drive current. The system may account for

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	non-linearity by adjusting drive signals, by adjusting amplification of received signal gain, by adjusting received signal processing, by any other suitable method, or any combination thereof. For example, the system may adjust the drive signal to an LED to improve the linearity. Corrections may be determined using a calibration step, lookup tables for known components, empirical data, any other suitable techniques, or any combination thereof. For example, the emission intensity relative to a drive signal may be known for a particular LED. Information may be encoded in a calibration resistor or non-volatile calibration memory included in the sensor or the system. In another example, the system may calibrate emission output by comparing the intensity of received signals generated in response to a high current drive signal with those generated in response to a low current drive signal. In some embodiments, the operating range of a component (e.g., an LED) may be limited. In some embodiments, a component may operate with a linear relationship between drive signal and output intensity within a known range of drive signals, and in a non-linear relationship outside that range of drive signals. In some embodiments of cardiac cycle modulation, the system may modulate multiple light sources using a plurality of modulation techniques. For example, in a system with two light sources, the system may operate a first light source at full or regular brightness, while operating one or more additional light sources in a switched or otherwise modulated mode. In some embodiments, the system may operate a first light source according to a first cardiac cycle modulation technique and a second light source according to a second cardiac modulation technique. The first and second cardiac cycle modulation techniques may be the same, correlated, or unrelated. In some embodiments, the system may use the first light source to determine periods of interest in the cardiac cycle. The system may, according to the periods of interest, power additional light sources, alter the modulation of the additional light sources, perform other suitable power optimization techniques, or any combination thereof. In some embodiments, the system may include a first light source (e.g., a light source powered at full or regular brightness) of a type that is a more efficient light source than the one or more additional light sources. For example, the first light source may be a high efficiency infrared (IR) LED while the one or more additional light sources may be lower efficiency red LEDs or laser diodes. In some embodiments, the first light source may be selected based on efficiency parameters and information from the first light source may be used only to control a second light source. For example, a highly efficient first light source that is not at a wavelength of interest for physiological parameter determination may be used to control one or more second light sources at wavelengths of interest. In this case, the light from the first light source may be used only for controlling the second light source and not for determining physiological parameters.

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	Lisogurski at 7:12-8:3. Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Lisogurski at 10:48-64. In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subjects tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being trans mitted to monitor 104. Lisogurski at 11:9-27. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, frontend processing circuitry 150 may synchronize the operation of an analog to-digital converter and a demultiplexer with the light drive signal based on the timing control signals.

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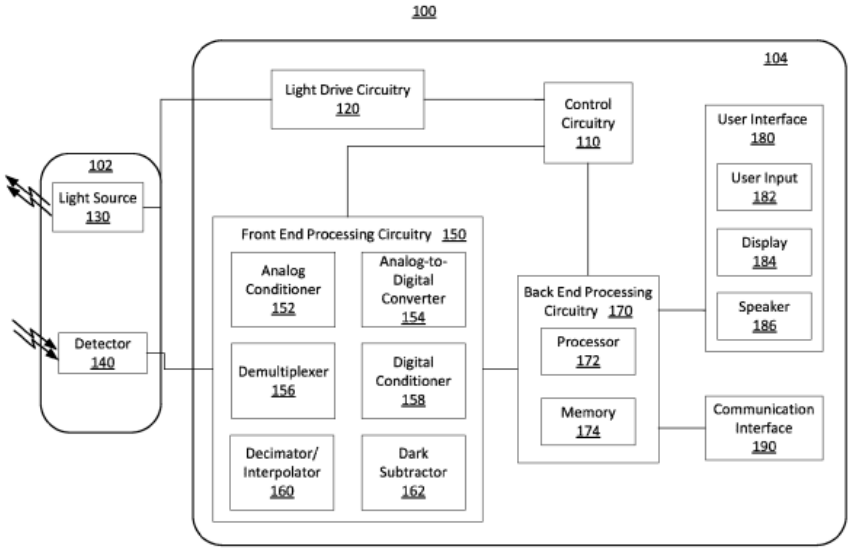
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	Lisgurski at 11:41-46. FIG. 2A shows an illustrative plot of a light drive signal including red light “on” period 202 and IR light “on period” 204 in accordance with some embodiments of the present disclosure. Light “on” periods 202, and 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, “on” and “off” may refer to switching power or other components, high and low output states, high and low values within a continuous modulation, high and low duty cycles, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red “on” period 202 and IR “on” period 204 to drive red and IR light emitters, respectively, within light source 130. Red “on” period 202 may have a higher amplitude than IR “on” period 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue at certain oxygen saturations. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary, and that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. Lisogurski at 11:61-12:22. In an embodiment, the subject may be a medical patient and display 184 may exhibit a list of values which may generally apply to the patient, such as, for example, age ranges or medication families, which the user may select using user input 182. Lisogurski at 15:26-30. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart.

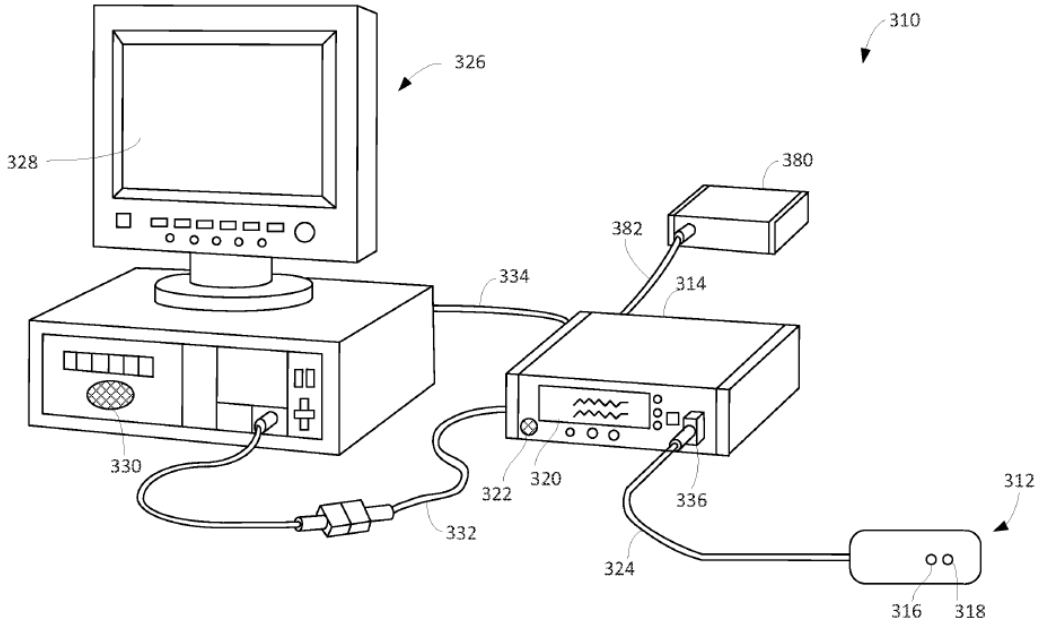
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	Lisogurski at 17:35-45. In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulation. For example, the first light drive signal may be configured to activate one LED to emit a photonic signal and not activate other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated. Lisogurski at 19:20-39. It will be understood that selection and/or switching of the first and second light sources may depend on the blood oxygen saturation as well as additional physiological parameters and system parameters. For example, a red wavelength LED may consume more power than an IR LED, and thus it may be desired to use the lowest power consuming technique possible. In some embodiments, the system may select the light source capable of detecting the greatest pulsatile amplitude per unit of power consumed. In some other embodiments, the system may select the light source capable of detecting the greatest pulsatile amplitude. It will also be understood that in some embodiments, a decreasing blood oxygen saturation or other physiological parameter may result in the system not using a cardiac cycle modulation technique in order to attain the highest possible quality physiological information. This will be discussed below, for example with relation to FIG. 21. FIG. 9 is flow diagram 900 showing illustrative steps for determining a physiological parameter in accordance with some embodiments of the present disclosure. In some embodiments, the system may emit a photonic signal correlated to physiological pulses from a light source, and use information from the related attenuated signal to determine physiological parameters. In some embodiments, varying

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	parameters of the light drive signal may reduce, optimize, or otherwise suitably alter the power consumption of the system. In step 902, the system may generate a light drive signal, in part correlated to physiological pulses. The system may generate a light drive signal used by a light source to emit a photonic signal. The light source may be one or more emitters of one or more wavelengths, and they may emit one or more photonic signals. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR LED. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. Lisogurski at 25:6-45. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d]. the wearable measurement device further comprising a receiver configured to:	Lisogurski discloses or renders obvious the wearable measurement device further comprising a receiver. *See* 11[a].

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	 FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 3 Lisogurski at Fig. 3. The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. The system may include, for example, a light source and a photosensitive detector. Lisogurski at 3:43-46. In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the

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	ambient light detected by the detector during the “dark” period and then subtract this ambient contribution from the signals received during the first and second “on” periods. In some embodiments, drive cycle modulation may be implemented using time division multiplexing as described above, code division multiplexing, carrier frequency multiplexing, phase division multiplexing, feedback circuitry, DC restoration circuitry, any other suitable technique, or any combination thereof. For example, the system may use frequency division multiplexing in a drive cycle modulation technique. The cardiac cycle modulation may represent a lower frequency envelope function on the higher frequency drive cycle. For example, cardiac cycle modulation may be an envelope on the order of 1 Hz superimposed on a 1 kHz sine wave drive cycle modulation. Lisogurski at 6:7-19. In some embodiments of cardiac cycle modulation, the system may modulate multiple light sources using a plurality of modulation techniques. For example, in a system with two light sources, the system may operate a first light source at full or regular brightness, while operating one or more additional light sources in a switched or otherwise modulated mode. Lisogurski at 7:38-43. For example, the first light source may be a high efficiency infrared (IR) LED while the one or more additional light sources may be lower efficiency red LEDs or laser diodes. Lisogurski at 7:58-61. As used herein, the terms “on” and “off” are merely exemplary and may not necessarily refer to a fully on or off state. For example, “on” and “off” may refer to switching power or other components, high and low brightness output states, high and low values within a continuous modulation, high and low values of electrical current provided to an emitter, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitter is switched on), any other suitable relatively distinct states, or any combination thereof. In some embodiments, “on” and “off” states may relate to high and low values of a variable that varies with multiple discrete steps. For example, an emitter brightness may be provided by the system as off, low, medium, and high. In this example, an “off” state may refer to off or low emission and “on” may refer to medium or high. In another example, “off” may refer to an off state and “on” may refer to a low, medium, or high output depending on a second input or system variable.

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	Lisogurski at 8:27-44. In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other suitable reasons, or any combination thereof. The system may receive, for example, an increased level of background noise in the signal due to patient motion. The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio. In some embodiments, the system may increase brightness throughout the cardiac cycle because the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion. In some embodiments, the system may change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light. Lisogurski at 9:46-60. FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals Lisogurski at 10:42-56. Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130. In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140

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	after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:6-27. Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Lisogurski at 11:33-49. Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Lisogurski at 12:42-51.

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	FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below. Lisogurski at 12:52-13:6. Referring back to FIG. 1, front end processing circuitry 150, which may receive a detection signal, such as detector current waveform 214, may include analog conditioner 152, analog-to-digital converter 154, demultiplexer 156, digital conditioner 158, decimator/interpolator 160, and dark subtractor 162. Analog conditioner 152 may perform any suitable analog conditioning of the detector signal. The conditioning performed may include any type of filtering (e.g., low pass, high pass, band pass, notch, or any other suitable filtering), amplifying, performing an operation on the received signal (e.g., taking a derivative, averaging), performing any other suitable signal conditioning (e.g., converting a current signal to a voltage signal), or any combination thereof. The conditioned analog signal may be processed by analog-to-digital converter 154, which may convert the conditioned analog signal into a digital signal. Analog-to-digital converter 154 may operate under the control of control circuitry 110. Analog-to-digital converter 154 may use timing control signals from control circuitry 110 to determine when to sample the analog signal. Analog-to-digital converter 154 may be any suitable type of analog-to-digital converter of sufficient resolution to enable a physiological monitor to accurately determine physiological parameters. Demultiplexer 156 may operate on the analog or digital form of the detector signal to separate out different components of the signal. For example, detector current waveform 214 of FIG. 2B includes a

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	Red component, an IR component, and at least one dark component. Demultiplexer 156 may operate on detector current waveform 214 of FIG. 2B to generate a Red signal, an IR signal, a first dark signal (e.g., corresponding to the dark component that occurs immediately after the Red component), and a second dark signal (e.g., corresponding to the dark component that occurs immediately after the IR component). Demultiplexer 156 may operate under the control of control circuitry 110. For example, demultiplexer 156 may use timing control signals from control circuitry 110 to identify and separate out the different components of the detector signal. Digital conditioner 158 may perform any suitable digital conditioning of the detector signal. The digital conditioner may include any type of digital filtering of the signal (e.g., low pass, high pass, band pass, notch, or any other suitable filtering), amplifying, performing an operation on the signal, performing any other suitable digital conditioning, or any combination thereof. Decimator/interpolator 160 may decrease the number of samples in the digital detector signal. For example, decimator/interpolator 160 may decrease the number of samples by removing samples from the detector signal or replacing samples with a smaller number of samples. The decimation or interpolation operation may include or be followed by filtering to smooth the output signal. Dark subtractor 162 may operate on the digital signal. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red “on” period 202 may be adjusted by determining the amount of dark signal during the “off” period 220 preceding red “on” period 202. The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red “on” period 202. Alternatively, the “off” period 220 after red “on” period 202 may be used to correct red “on” period 202 rather than the “off” period 220 preceding it. Additionally, an average of the “off” periods 220 before and after red “on” period 202 may be used. The components of front end processing circuitry 150 are merely illustrative and any suitable components and combinations of components may be used to perform the front end processing operations. The front end processing circuitry 150 may be configured to take advantage of the full dynamic range of analog-to-digital converter 154. This may be achieved by applying gain to the detection signal by analog conditioner 152 to map the expected range of the detection signal to the full or close to full output range of analog-to-digital converter 154. The output value of analog-to-digital converter 154, as a function of the total analog gain applied to the detection signal, may be given as:

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	ADC Value∝Total Analog Gain×[Ambient Light+LED Light]. Ideally, when ambient light is zero and when the light source is off, the analog-to-digital converter 154 will read just above the minimum input value. When the light source is on, the total analog gain may be set such that the output of analog-to-digital converter 154 may read close to the full scale of analog-to-digital converter 154 without saturating. This may allow the full dynamic range of analog-to-digital converter 154 to be used for representing the detection signal, thereby increasing the resolution of the converted signal. In some embodiments, the total analog gain may be reduced by a small amount so that small changes in the light level incident on the detector do not cause saturation of analog-to-digital converter 154. However, if the contribution of ambient light is large relative to the contribution of light from a light source, the total analog gain applied to the detection current may need to be reduced to avoid saturating analog-to-digital converter 154. When the analog gain is reduced, the portion of the signal corresponding to the light source may map to a smaller number of analog-to-digital conversion bits. Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Lisogurski at 13:7-14:55. Processor 172 may receive and process physiological signals received from front end processing circuitry 150. Lisogurski at 14:60-62. It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments,

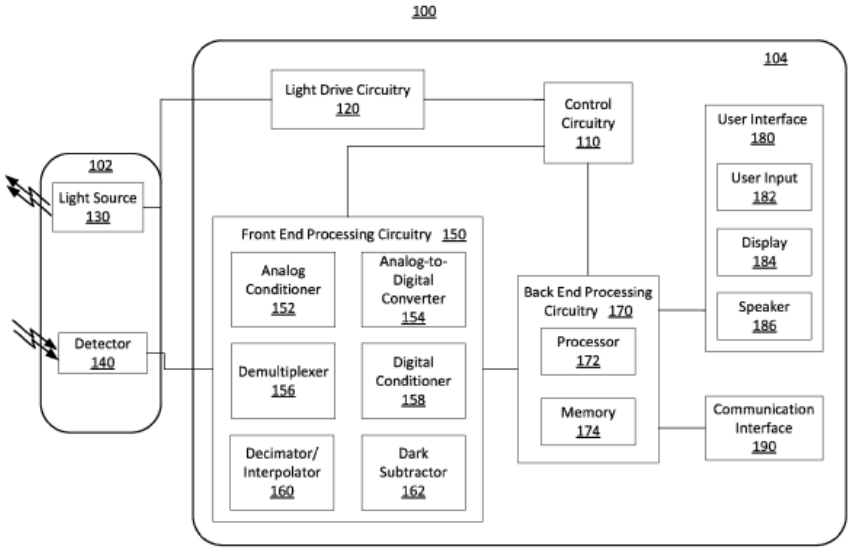
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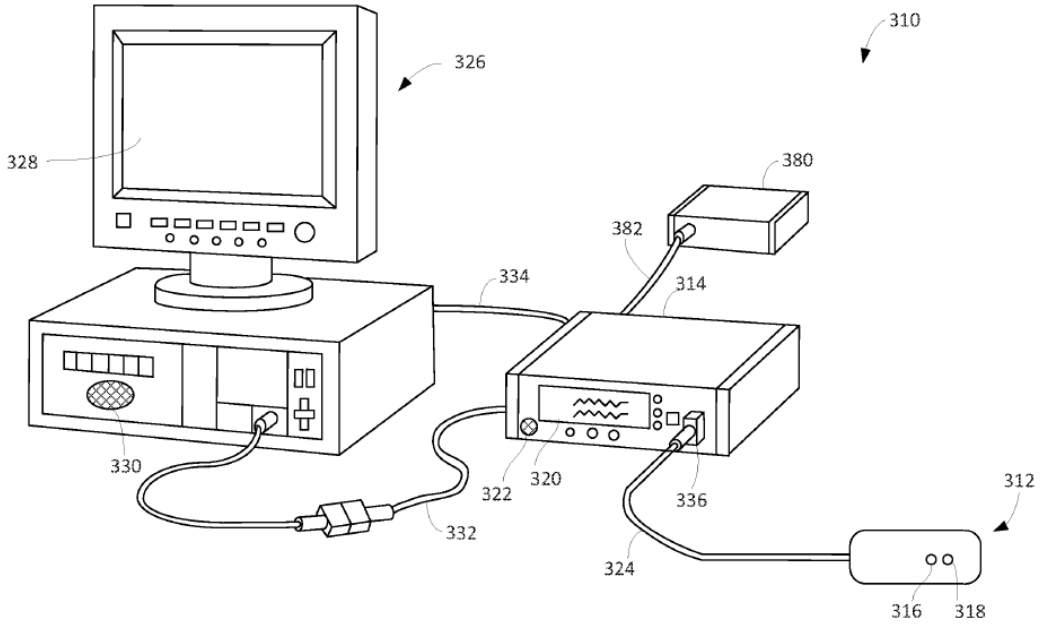
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	the functionality of one or more of the components may be performed in a different order or may not be required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Lisogurski at 15:66-16:16. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Lisogurski at 17:35-45. In some embodiments, sensor unit 312 may be communicatively coupled to monitor 314 via a cable 324. Cable 324 may include electronic conductors (e.g., wires for transmitting electronic signals from detector 318), optical fibers (e.g., multi-mode or single-mode fibers for transmitting emitted light from light source 316), any other suitable components, any suitable insulation or sheathing, or any combination thereof. Lisogurski at 18:16-23. In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. In some embodiments, any of the processing components and/or circuits, or portions thereof, of FIGS. 1 and 3 may be referred to collectively as processing equipment. For example, processing equipment may be configured to generate light drive signals, amplify, filter, sample and digitize detector signals, and calculate physiological information from the digitized signal. In some embodiments, all or some of the components of the processing equipment may be referred to as a processing module. Lisogurski at 19:1-12.

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	In some embodiments, physiological pulses may be cardiac pulses, respiratory pulses, muscular pulses, any other suitable pulses, or any combination thereof. Where physiological pulses are respiratory pulses, they may relate to respiration rate, inspiration, expiration, ventilator parameters, changes in a respiratory pressure signals, any other 5 suitable parameter, or any combination thereof. In some embodiments, particular segments of a respiratory cycle may provide an increased signal to noise ratio, increased signal strength, increased physiological parameter accuracy, increased physiological parameter precision, any other suitable parameters, or any combination thereof. In some embodiments, respiration may cause variations in photoplethysmography data, and thus it may be desired to correlate a modulation technique with respiration variations or both respiration variations and cardiac pulses. Lisogurski at 25:66-26:14. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample,	Lisogurski discloses or renders obvious the receiver configured to: receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. *See* 11[c], 11[d].

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	 FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 3 Lisogurski at Fig. 3. The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. The system may include, for example, a light source and a photosensitive detector. Lisogurski at 3:43-46. In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the

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	ambient light detected by the detector during the “dark” period and then subtract this ambient contribution from the signals received during the first and second “on” periods. In some embodiments, drive cycle modulation may be implemented using time division multiplexing as described above, code division multiplexing, carrier frequency multiplexing, phase division multiplexing, feedback circuitry, DC restoration circuitry, any other suitable technique, or any combination thereof. For example, the system may use frequency division multiplexing in a drive cycle modulation technique. The cardiac cycle modulation may represent a lower frequency envelope function on the higher frequency drive cycle. For example, cardiac cycle modulation may be an envelope on the order of 1 Hz superimposed on a 1 kHz sine wave drive cycle modulation. Lisogurski at 6:7-19. As used herein, the terms “on” and “off” are merely exemplary and may not necessarily refer to a fully on or off state. For example, “on” and “off” may refer to switching power or other components, high and low brightness output states, high and low values within a continuous modulation, high and low values of electrical current provided to an emitter, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitter is switched on), any other suitable relatively distinct states, or any combination thereof. In some embodiments, “on” and “off” states may relate to high and low values of a variable that varies with multiple discrete steps. For example, an emitter brightness may be provided by the system as off, low, medium, and high. In this example, an “off” state may refer to off or low emission and “on” may refer to medium or high. In another example, “off” may refer to an off state and “on” may refer to a low, medium, or high output depending on a second input or system variable. Lisogurski at 8:27-44. In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other suitable reasons, or any combination thereof. The system may receive, for example, an increased level of background noise in the signal due to patient motion. The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio. In some embodiments, the system may increase brightness throughout the cardiac cycle because the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion. In some embodiments, the system may change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light.

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	Lisogurski at 9:46-60. FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Lisogurski at 10:42-47. Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130. In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:6-27. Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an

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	analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Lisogurski at 11:33-49. Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Lisogurski at 12:42-51. FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below. Lisogurski at 12:52-13:6.

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	Referring back to FIG. 1, front end processing circuitry 150, which may receive a detection signal, such as detector current waveform 214, may include analog conditioner 152, analog-to-digital converter 154, demultiplexer 156, digital conditioner 158, decimator/interpolator 160, and dark subtractor 162. Analog conditioner 152 may perform any suitable analog conditioning of the detector signal. The conditioning performed may include any type of filtering (e.g., low pass, high pass, band pass, notch, or any other suitable filtering), amplifying, performing an operation on the received signal (e.g., taking a derivative, averaging), performing any other suitable signal conditioning (e.g., converting a current signal to a voltage signal), or any combination thereof. The conditioned analog signal may be processed by analog-to-digital converter 154, which may convert the conditioned analog signal into a digital signal. Analog-to-digital converter 154 may operate under the control of control circuitry 110. Analog-to-digital converter 154 may use timing control signals from control circuitry 110 to determine when to sample the analog signal. Analog-to-digital converter 154 may be any suitable type of analog-to-digital converter of sufficient resolution to enable a physiological monitor to accurately determine physiological parameters. Demultiplexer 156 may operate on the analog or digital form of the detector signal to separate out different components of the signal. For example, detector current waveform 214 of FIG. 2B includes a Red component, an IR component, and at least one dark component. Demultiplexer 156 may operate on detector current waveform 214 of FIG. 2B to generate a Red signal, an IR signal, a first dark signal (e.g., corresponding to the dark component that occurs immediately after the Red component), and a second dark signal (e.g., corresponding to the dark component that occurs immediately after the IR component). Demultiplexer 156 may operate under the control of control circuitry 110. For example, demultiplexer 156 may use timing control signals from control circuitry 110 to identify and separate out the different components of the detector signal. Digital conditioner 158 may perform any suitable digital conditioning of the detector signal. The digital conditioner may include any type of digital filtering of the signal (e.g., low pass, high pass, band pass, notch, or any other suitable filtering), amplifying, performing an operation on the signal, performing any other suitable digital conditioning, or any combination thereof. Decimator/interpolator 160 may decrease the number of samples in the digital detector signal. For example, decimator/interpolator 160 may decrease the number of samples by removing samples from the detector signal or replacing samples with a smaller number of samples. The decimation or interpolation operation may include or be followed by filtering to smooth the output signal. Dark subtractor 162 may operate on the digital signal. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, dark subtractor 162 may determine a subtraction amount from the dark signal portion of the

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	detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red “on” period 202 may be adjusted by determining the amount of dark signal during the “off” period 220 preceding red “on” period 202. The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red “on” period 202. Alternatively, the “off” period 220 after red “on” period 202 may be used to correct red “on” period 202 rather than the “off” period 220 preceding it. Additionally, an average of the “off” periods 220 before and after red “on” period 202 may be used. The components of front end processing circuitry 150 are merely illustrative and any suitable components and combinations of components may be used to perform the front end processing operations. The front end processing circuitry 150 may be configured to take advantage of the full dynamic range of analog-to-digital converter 154. This may be achieved by applying gain to the detection signal by analog conditioner 152 to map the expected range of the detection signal to the full or close to full output range of analog-to-digital converter 154. The output value of analog-to-digital converter 154, as a function of the total analog gain applied to the detection signal, may be given as: ADC Value∝Total Analog Gain×[Ambient Light+LED Light]. Ideally, when ambient light is zero and when the light source is off, the analog-to-digital converter 154 will read just above the minimum input value. When the light source is on, the total analog gain may be set such that the output of analog-to-digital converter 154 may read close to the full scale of analog-to-digital converter 154 without saturating. This may allow the full dynamic range of analog-to-digital converter 154 to be used for representing the detection signal, thereby increasing the resolution of the converted signal. In some embodiments, the total analog gain may be reduced by a small amount so that small changes in the light level incident on the detector do not cause saturation of analog-to-digital converter 154. However, if the contribution of ambient light is large relative to the contribution of light from a light source, the total analog gain applied to the detection current may need to be reduced to avoid saturating analog-to-digital converter 154. When the analog gain is reduced, the portion of the signal corresponding to the light source may map to a smaller number of analog-to-digital conversion bits. Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal.

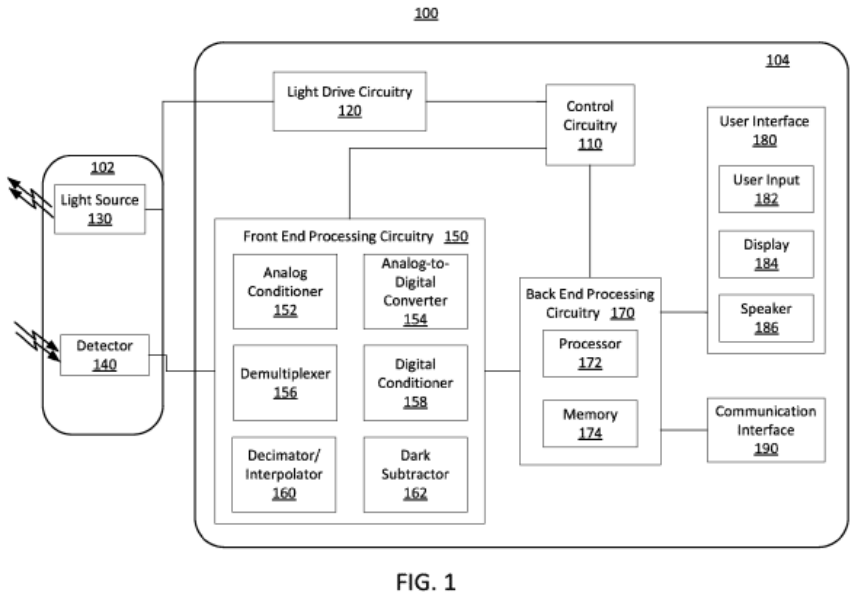
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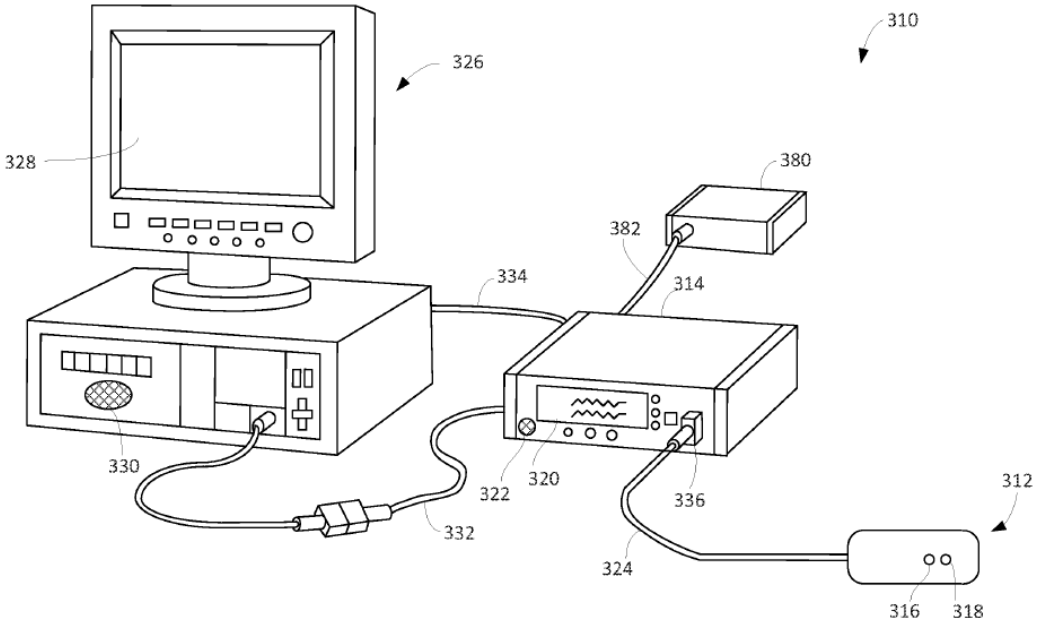
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	Lisogurski at 13:7-14:55. Processor 172 may receive and process physiological signals received from front end processing circuitry 150. Lisogurski at 14:60-62. It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Lisogurski at 15:66-16:16. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Lisogurski at 17:35-45. In some embodiments, sensor unit 312 may be communicatively coupled to monitor 314 via a cable 324. Cable 324 may include electronic conductors (e.g., wires for transmitting electronic signals from detector

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	318), optical fibers (e.g., multi-mode or single-mode fibers for transmitting emitted light from light source 316), any other suitable components, any suitable insulation or sheathing, or any combination thereof. Lisogurski at 18:16-23 In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. In some embodiments, any of the processing components and/or circuits, or portions thereof, of FIGS. 1 and 3 may be referred to collectively as processing equipment. For example, processing equipment may be configured to generate light drive signals, amplify, filter, sample and digitize detector signals, and calculate physiological information from the digitized signal. In some embodiments, all or some of the components of the processing equipment may be referred to as a processing module. Lisogurski at 19:1-12 In some embodiments, physiological pulses may be cardiac pulses, respiratory pulses, muscular pulses, any other suitable pulses, or any combination thereof. Where physiological pulses are respiratory pulses, they may relate to respiration rate, inspiration, expiration, ventilator parameters, changes in a respiratory pressure signals, any other 5 suitable parameter, or any combination thereof. In some embodiments, particular segments of a respiratory cycle may provide an increased signal to noise ratio, increased signal strength, increased physiological parameter accuracy, increased physiological parameter precision, any other suitable parameters, or any combination thereof. In some embodiments, respiration may cause variations in photoplethysmography data, and thus it may be desired to correlate a modulation technique with respiration variations or both respiration variations and cardiac pulses. Lisogurski at 25:66-26:14 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Lisogurski discloses the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. *See* 11[c], 11[d].  FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 3 Lisogurski at Fig. 3. Systems and methods are provided for optimizing power consumption in an optical physiological monitoring system. The system may vary light drive signal parameters to reduce power consumption or vary power use. The system may vary parameters in a technique correlated to cardiac pulse cycles. In some embodiments, reducing power consumption may allow for increased battery life in portable systems or increased portability. In some embodiments, varying light output during a cardiac cycle may reduce heating effects of the emitters. Parameters that may be varied include light intensity, firing rate, duty cycle, other suitable parameters, or any combination thereof. The generated signals may be used to determined physiological parameters such as blood oxygen saturation, hemoglobin, blood pressure, pulse rate, other suitable parameters, or any combination thereof. Lisogurski at 1:10-25.

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	The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. The system may include, for example, a light source and a photosensitive detector. Providing a light drive signal to the light source may account for a significant portion of the systems total power consumption. Thus, it may be desirable to reduce the power consumption of the light source, while still enabling high quality physiological parameters to be determined. The system may reduce the power consumption by modulating parameters associated with the light drive signal in techniques correlated to the cardiac cycle or other cyclical physiological activity. For example, the system may decrease brightness during a particular portion of the cardiac cycle. It may also be desirable to reduce the power consumption by the light drive signal to reduce heating effects caused by an emitter. An oximeter is a medical device that may determine the oxygen saturation of an analyzed tissue. One common type of oximeter is a pulse oximeter, which may non-invasively measure the oxygen saturation of a patient's blood (as opposed to measuring oxygen saturation directly by analyzing a blood sample taken from the patient). Pulse oximeters may be included in patient monitoring systems that measure and display various blood flow characteristics including, but not limited to, the oxygen saturation of hemoglobin in arterial blood. Such patient monitoring systems may also measure and display additional physiological parameters, such as a patient's pulse rate and blood pressure. Lisogurski at 3:43-4:5. An oximeter may include a light sensor that is placed at a site on a patient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot. The oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically understood to be optimal for pulse oximetry serve as suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional suitable sensor locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patient's thigh to monitor femoral artery pulsatile flow, the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. Suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. In all suitable locations, for example, the oximeter may measure the intensity of light that

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	is received at the light sensor as a function of time. The oximeter may also include sensors at multiple locations. A signal representing light intensity versus time or a mathematical manipulation of this signal (e.g., a scaled version thereof: a logarithm taken thereof, a scaled version of a logarithm taken thereof; a derivative taken thereof, a difference taken thereof, etc.) may be referred to as the photoplethysmograph (PPG) signal. In addition, the term “PPG signal” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue), a transmission signal (i.e., representing the amount of light received from the tissue), any Suitable mathematical manipulation thereof; or any combination thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs. Lisogurski at 4:6-41. In some applications, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Red and infrared (IR) wave lengths may be used because it has been observed that highly oxygenated blood will absorb relatively less red light and more IR light than blood with a lower oxygen saturation. By comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen saturation of hemoglobin in arterial blood. The system may process data to determine physiological parameters using techniques well known in the art. For example, the system may determine blood oxygen saturation using two wavelengths of light and a ratio-of-ratios calculation. The system also may identify pulses and determine pulse amplitude, respiration, blood pressure, other Suitable parameters, or any combination thereof, using any suitable calculation techniques. In some embodiments, the system may use information from external sources (e.g., tabulated data, secondary sensor devices) to determine physiological parameters. In some embodiments, it may be desirable to implement techniques to optimize power consumption in an oximeter or other system. Lisogurski at 4:42-65. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140.

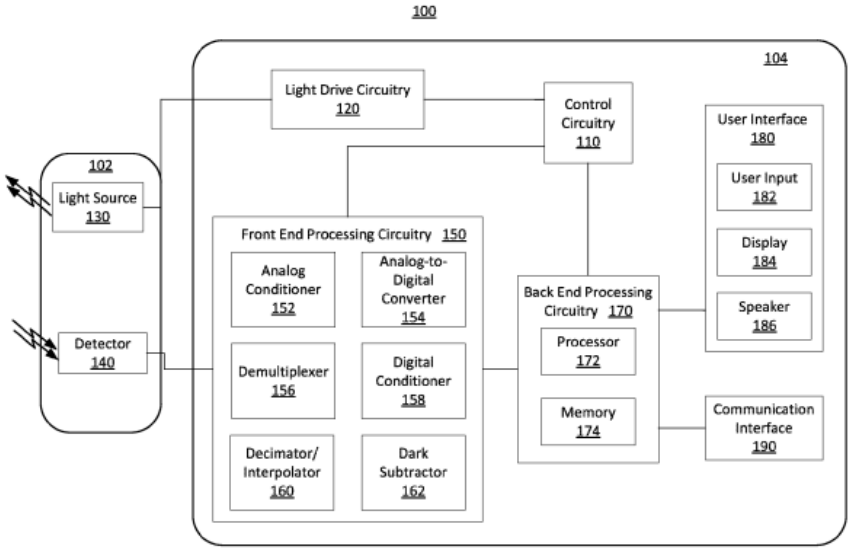
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	Lisogurski at 10:46-49 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In Some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subjects tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the Subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. In the embodiment shown, monitor 104 includes control circuitry 110, light drive circuitry 120, front end processing circuitry 150, back end processing circuitry 170, user inter face 180, and communication interface 190. Monitor 104 may be communicatively coupled to sensor 102. Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, frontend processing circuitry 150 may synchronize the operation of an analog to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Light drive circuitry 120, as discussed above, may be con figured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of when light source 130 is turned on and off. Lisogurski at 11:9-54

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	Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. Lisogurski at 12:42-45 Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Lisogurski at 17:55-59 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	Lisogurski discloses or renders obvious the receiver configured to synchronize to the light source. *See* 11[a], 11[d].

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	 FIG. 1 Lisogurski at Fig. 1. The system may, in response to the external rigger, vary the light intensity, duty cycle, light source firing rate, any other suitable parameter, or any combination thereof. Lisogurski at 1:67-2:2. As used herein, the terms “on” and “off” are merely exemplary and may not necessarily refer to a fully on or off state. For example, “on” and “off” may refer to switching power or other components, high and low brightness output states, high and low values within a continuous modulation, high and low values of electrical current provided to an emitter, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitter is switched on), any other suitable relatively distinct states, or any combination thereof. In some embodiments, “on” and “off” states may relate to high and low values of a variable that varies with multiple discrete steps. For example, an emitter brightness may be provided by the system as off, low, medium, and high. In this example, an “off” state may refer to off or

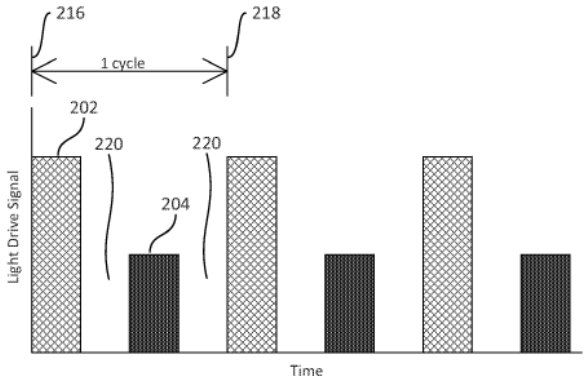
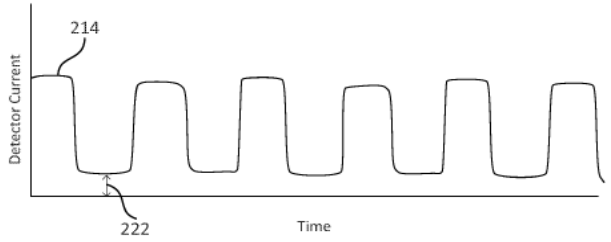
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	low emission and “on” may refer to medium or high. In another example, “off” may refer to an off state and “on” may refer to a low, medium, or high output depending on a second input or system variable. Lisogurski at 8:27-44. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog to digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Light drive circuitry 120, as discussed above, may be configured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of when light source 130 is turned on and off. When light source 130 is configured to emit two or more wave lengths of light, the light drive signal may be configured to control the operation of each wavelength of light. The light drive signal may comprise a single signal or may comprise multiple signals (e.g., one signal for each wavelength of light). An illustrative light drive signal is shown in FIG. 2A. FIG. 2A shows an illustrative plot of a light drive signal including red light “on” period 202 and IR light "on period” 204 in accordance with some embodiments of the present disclosure. Light “on” periods 202, and 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, “on” and “off” may refer to switching power or other components, high and low output states, high and low values within a continuous modulation, high and low duty cycles, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red “on” period 202 and IR “on” period 204 to drive red and IR light emitters, respectively, within light source 130. Red “on” period 202 may have a higher amplitude than IR “on” period 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. Lisogurski at 11:41-12:9. FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being

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	emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below. Lisogurski at 12:52-13:6. Time interval 284 may include a sequence of red "on" portion 286, a first "off' portion 288, IR "on" portion 290, and a second "off' portion 292. Lisogurski at 16:66-17:2. It will also be understood that modulation of the light drive signal (i.e., the "on" and "off' states illustrated by light drive signal 1010) is merely exemplary and may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof. It will also be understood that the "on" and "off' states are merely exemplary and that the system may use any suitable variations of discrete and/or continuous modulations. Lisogurski at 27:44-52. In some embodiments, sampling rate modulation may be correlated with light drive signal modulation. Lisogurski at 33:47-49. In this embodiment, the firing rate of the emitters may not be modulated along with the analog-to-digital sampling rate. For example, at a low sampling rate, the system may sample once per "on" period, while at a high sampling rate the system may take several samples per "on" period and average them. In some

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	embodiments, averaging multiple samples for the same "on" period may include oversampling techniques. Lisogurski at 35:16-23. For example, the time between "on" periods may be the length of time of "off' period 220 of FIG. 2A. Increasing the duration of the "off' periods (i.e., decreasing the emitter firing rate) relates to a decreased sampling rate. Similarly, decreasing the duration of the "off' periods (i.e., increasing the emitter firing rate) relates to an increased sampling rate. Lisogurski at 35:25-31. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the captured light into a first signal,	Lisogurski discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal. *See* 11[a], 11[d].

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	 FIG. 2A Lisogurski at FIGS. 2A.  FIG. 2B Lisogurski at FIGS. 2B. In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a "dark" period, followed by a second light source, followed by a "dark" period. The system may measure the

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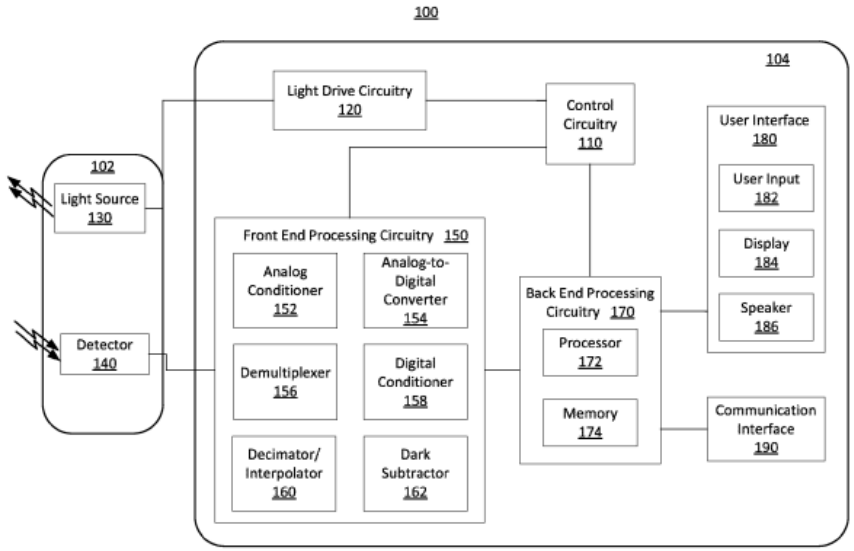
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	ambient light detected by the detector during the "dark" period and then subtract this ambient contribution from the signals received during the first and second "on" periods. Lisogurski at 6:7-19. For example, the system may operate the first light source at full or regular brightness for a first “on” period, and then “off” for a second period. The system may use the first “on” period to adjust or calibrate a second modulation technique. The system may implement the second modulation technique for the “off” period, using, for example, one or more light sources that may or may not include the first light source. Lisogurski at 8:16-23. In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subjects tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. Lisogurski at 11:9-20. FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may

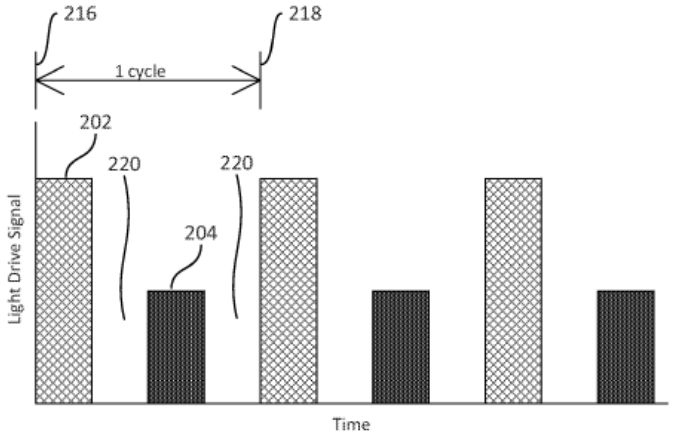
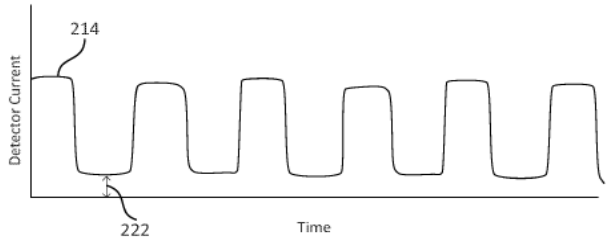
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	interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below. Lisogurski at 12:52-13:6. Demultiplexer 156 may operate on the analog or digital form of the detector signal to separate out different components of the signal. For example, detector current waveform 214 of FIG. 2B includes a Red component, an IR component, and at least one dark component. Demultiplexer 156 may operate on detector current waveform 214 of FIG. 2B to generate a Red signal, an IR signal, a first dark signal (e.g., corresponding to the dark component that occurs immediately after the Red component), and a second dark signal (e.g., corresponding to the dark component that occurs immediately after the IR component). Lisogurski at 13:31-41. Dark subtractor 162 may operate on the digital signal. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red “on” period 202 may be adjusted by determining the amount of dark signal during the “off” period 220 preceding red “on” period 202. The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red “on” period 202. Alternatively, the “off” period 220 after red “on” period 202 may be used to correct red “on” period 202 rather than the “off” period 220 preceding it. Additionally, an average of the “off” periods 220 before and after red “on” period 202 may be used. Lisogurski at 13:60-14:10. Region 256 of plot 250 indicates an interval of the timing diagram where both red light modulation 252 and IR light modulation 254 are in an "on" portion of the cardiac cycle modulation. Plot 270 shows an illustrative portion of region 256, where the system is employing a cardiac cycle modulation in addition to the drive cycle modulation. Plot 250 may include a drive cycle modulation technique with a period of time interval 272. The time scale of plot 270 may be significantly shorter than the time scale of plot 250,

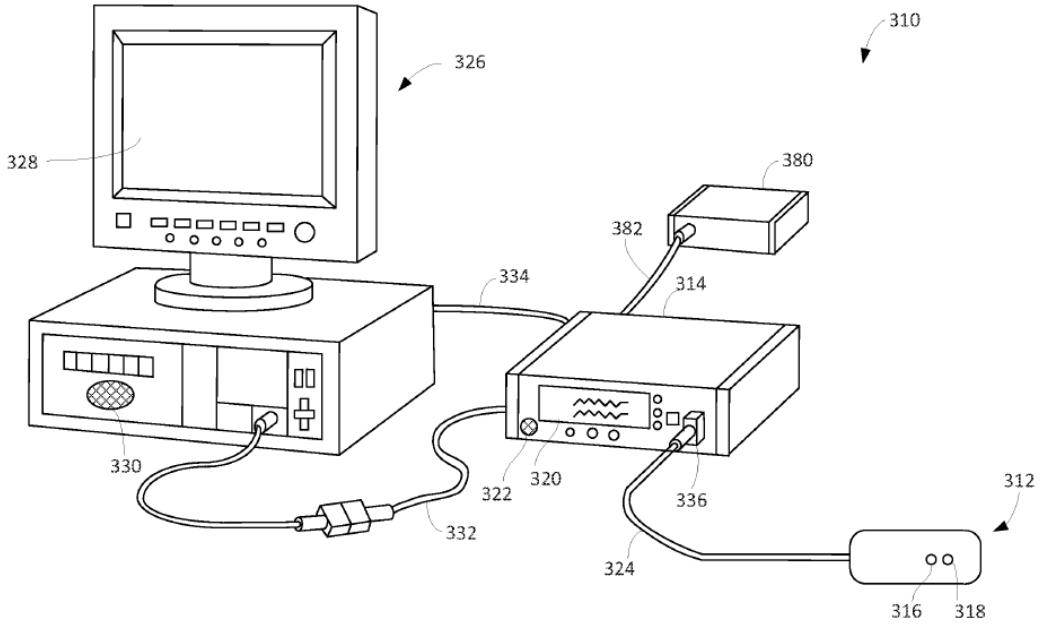
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	such that time interval 272 is significantly shorter than time interval 260. For example, time interval 260 (i.e., the period of the cardiac cycle modulation) may be on the order of 1 second, while time interval 272 (i.e., the period of the drive cycle modulation) may be on the order of 1 ms. Time interval 272 may include a sequence of red "on" portion 274, a first "off' portion 276, IR "on" portion 278, and a second "off' portion 280. The first "off' portion 276 and second "off' portion 280 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red "on" portion 274 and IR "on" period 278. Lisogurski at 16:33-53. The system may subtract the back ground or dark level from the levels received during red “on” portion 286 and IR “on” portion 290. Lisogurski at 17:8-10. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the Subject's tissue. Lisogurski at 17:40-42. In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. Lisogurski at 19:20-27. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Lisogurski discloses or renders obvious the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* 11[a], 11[d], 11[e].  FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 2A Lisogurski at FIGS. 2A.  FIG. 2B Lisogurski ar Fig. 2B.

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	 FIG. 3 Lisogurski at Fig. 3. The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. The system may include, for example, a light source and a photosensitive detector. Lisogurski at 3:43-46. In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the ambient light detected by the detector during the “dark” period and then subtract this ambient

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	contribution from the signals received during the first and second “on” periods. In some embodiments, drive cycle modulation may be implemented using time division multiplexing as described above, code division multiplexing, carrier frequency multiplexing, phase division multiplexing, feedback circuitry, DC restoration circuitry, any other suitable technique, or any combination thereof. For example, the system may use frequency division multiplexing in a drive cycle modulation technique. The cardiac cycle modulation may represent a lower frequency envelope function on the higher frequency drive cycle. For example, cardiac cycle modulation may be an envelope on the order of 1 Hz superimposed on a 1 kHz sine wave drive cycle modulation. Lisogurski at 6:7-19. For example, the first light source may be a high efficiency infrared (IR) LED while the one or more additional light sources may be lower efficiency red LEDs or laser diodes. Lisogurski at 7:58-61. For example, the system may operate the first light source at full or regular brightness for a first “on” period, and then “off” for a second period. The system may use the first “on” period to adjust or calibrate a second modulation technique. The system may implement the second modulation technique for the “off” period, using, for example, one or more light sources that may or may not include the first light source. Lisogurski at 8:16-23. As used herein, the terms “on” and “off” are merely exemplary and may not necessarily refer to a fully on or off state. For example, “on” and “off” may refer to switching power or other components, high and low brightness output states, high and low values within a continuous modulation, high and low values of electrical current provided to an emitter, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitter is switched on), any other suitable relatively distinct states, or any combination thereof. In some embodiments, “on” and “off” states may relate to high and low values of a variable that varies with multiple discrete steps. For example, an emitter brightness may be provided by the system as off, low, medium, and high. In this example, an “off” state may refer to off or low emission and “on” may refer to medium or high. In another example, “off” may refer to an off state and “on” may refer to a low, medium, or high output depending on a second input or system variable.

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	Lisogurski at 8:27-44. In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other suitable reasons, or any combination thereof. The system may receive, for example, an increased level of background noise in the signal due to patient motion. The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio. In some embodiments, the system may increase brightness throughout the cardiac cycle because the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion. In some embodiments, the system may change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light. Lisogurski at 9:46-60. FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Lisogurski at 10:42-47. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. Lisogurski at 10:52-56. Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130. In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140

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	after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:6-27. Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Lisogurski at 11:33-49. Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Lisogurski at 12:42-51.

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	FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below. Lisogurski at 12:52-13:6. Referring back to FIG. 1, front end processing circuitry 150, which may receive a detection signal, such as detector current waveform 214, may include analog conditioner 152, analog-to-digital converter 154, demultiplexer 156, digital conditioner 158, decimator/interpolator 160, and dark subtractor 162. Analog conditioner 152 may perform any suitable analog conditioning of the detector signal. The conditioning performed may include any type of filtering (e.g., low pass, high pass, band pass, notch, or any other suitable filtering), amplifying, performing an operation on the received signal (e.g., taking a derivative, averaging), performing any other suitable signal conditioning (e.g., converting a current signal to a voltage signal), or any combination thereof. The conditioned analog signal may be processed by analog-to-digital converter 154, which may convert the conditioned analog signal into a digital signal. Analog-to-digital converter 154 may operate under the control of control circuitry 110. Analog-to-digital converter 154 may use timing control signals from control circuitry 110 to determine when to sample the analog signal. Analog-to-digital converter 154 may be any suitable type of analog-to-digital converter of sufficient resolution to enable a physiological monitor to accurately determine physiological parameters. Demultiplexer 156 may operate on the analog or digital form of the detector signal to separate out different components of the signal. For example, detector current waveform 214 of FIG. 2B includes a

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	Red component, an IR component, and at least one dark component. Demultiplexer 156 may operate on detector current waveform 214 of FIG. 2B to generate a Red signal, an IR signal, a first dark signal (e.g., corresponding to the dark component that occurs immediately after the Red component), and a second dark signal (e.g., corresponding to the dark component that occurs immediately after the IR component). Demultiplexer 156 may operate under the control of control circuitry 110. For example, demultiplexer 156 may use timing control signals from control circuitry 110 to identify and separate out the different components of the detector signal. Digital conditioner 158 may perform any suitable digital conditioning of the detector signal. The digital conditioner may include any type of digital filtering of the signal (e.g., low pass, high pass, band pass, notch, or any other suitable filtering), amplifying, performing an operation on the signal, performing any other suitable digital conditioning, or any combination thereof. Decimator/interpolator 160 may decrease the number of samples in the digital detector signal. For example, decimator/interpolator 160 may decrease the number of samples by removing samples from the detector signal or replacing samples with a smaller number of samples. The decimation or interpolation operation may include or be followed by filtering to smooth the output signal. Dark subtractor 162 may operate on the digital signal. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red “on” period 202 may be adjusted by determining the amount of dark signal during the “off” period 220 preceding red “on” period 202. The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red “on” period 202. Alternatively, the “off” period 220 after red “on” period 202 may be used to correct red “on” period 202 rather than the “off” period 220 preceding it. Additionally, an average of the “off” periods 220 before and after red “on” period 202 may be used. The components of front end processing circuitry 150 are merely illustrative and any suitable components and combinations of components may be used to perform the front end processing operations. The front end processing circuitry 150 may be configured to take advantage of the full dynamic range of analog-to-digital converter 154. This may be achieved by applying gain to the detection signal by analog conditioner 152 to map the expected range of the detection signal to the full or close to full output range of analog-to-digital converter 154. The output value of analog-to-digital converter 154, as a function of the total analog gain applied to the detection signal, may be given as:

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	ADC Value∝Total Analog Gain×[Ambient Light+LED Light]. Ideally, when ambient light is zero and when the light source is off, the analog-to-digital converter 154 will read just above the minimum input value. When the light source is on, the total analog gain may be set such that the output of analog-to-digital converter 154 may read close to the full scale of analog-to-digital converter 154 without saturating. This may allow the full dynamic range of analog-to-digital converter 154 to be used for representing the detection signal, thereby increasing the resolution of the converted signal. In some embodiments, the total analog gain may be reduced by a small amount so that small changes in the light level incident on the detector do not cause saturation of analog-to-digital converter 154. However, if the contribution of ambient light is large relative to the contribution of light from a light source, the total analog gain applied to the detection current may need to be reduced to avoid saturating analog-to-digital converter 154. When the analog gain is reduced, the portion of the signal corresponding to the light source may map to a smaller number of analog-to-digital conversion bits. Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Lisogurski at 13:7-14:55. Processor 172 may receive and process physiological signals received from front end processing circuitry 150. Lisogurski at 14:60-62. It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple components. For example, some or all of the functionality of control circuitry 110 may be performed in

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	front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Lisogurski at 15:66-16:16. Region 256 of plot 250 indicates an interval of the timing diagram where both red light modulation 252 and IR light modulation 254 are in an “on” portion of the cardiac cycle modulation. Plot 270 shows an illustrative portion of region 256, where the system is employing a cardiac cycle modulation in addition to the drive cycle modulation. Plot 250 may include a drive cycle modulation technique with a period of time interval 272. The time scale of plot 270 may be significantly shorter than the time scale of plot 250, such that time interval 272 is significantly shorter than time interval 260. For example, time interval 260 (i.e., the period of the cardiac cycle modulation) may be on the order of 1 second, while time interval 272 (i.e., the period of the drive cycle modulation) may be on the order of 1 ms. Time interval 272 may include a sequence of red “on” portion 274, a first “off” portion 276, IR “on” portion 278, and a second “off” portion 280. The first “off” portion 276 and second “off” portion 280 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red "on" portion 274 and IR "on" period 278. Lisogurski at 16:33-53. The system may subtract the background or dark level from the levels received during red "on" portion 286 and IR "on" portion 290. Lisogurski at 17:8-10. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart.

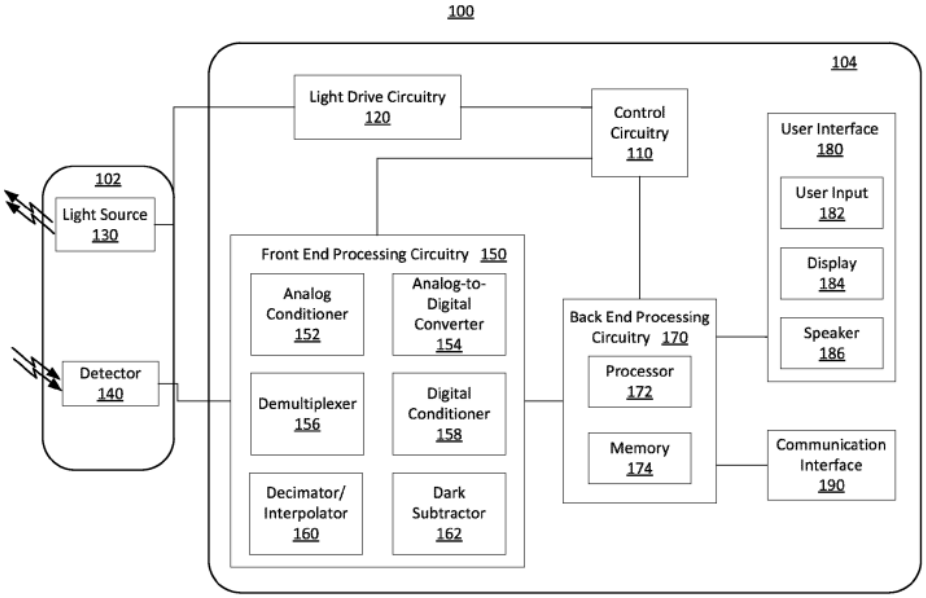
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	Lisogurski at 17:35-45. In some embodiments, sensor unit 312 may be communicatively coupled to monitor 314 via a cable 324. Cable 324 may include electronic conductors (e.g., wires for transmitting electronic signals from detector 318), optical fibers (e.g., multi-mode or single-mode fibers for transmitting emitted light from light source 316), any other suitable components, any suitable insulation or sheathing, or any combination thereof. Lisogurski at 18:16-23. In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. In some embodiments, any of the processing components and/or circuits, or portions thereof, of FIGS. 1 and 3 may be referred to collectively as processing equipment. For example, processing equipment may be configured to generate light drive signals, amplify, filter, sample and digitize detector signals, and calculate physiological information from the digitized signal. In some embodiments, all or some of the components of the processing equipment may be referred to as a processing module. Lisogurski at 19:1-12. In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. Lisogurski at 19:20-27. In some embodiments, physiological pulses may be cardiac pulses, respiratory pulses, muscular pulses, any other suitable pulses, or any combination thereof. Where physiological pulses are respiratory pulses, they may relate to respiration rate, inspiration, expiration, ventilator parameters, changes in a respiratory pressure signals, any other 5 suitable parameter, or any combination thereof. In some embodiments, particular segments of a respiratory cycle may provide an increased signal to noise ratio, increased signal

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	strength, increased physiological parameter accuracy, increased physiological parameter precision, any other suitable parameters, or any combination thereof. In some embodiments, respiration may cause variations in photoplethysmography data, and thus it may be desired to correlate a modulation technique with respiration variations or both respiration variations and cardiac pulses. Lisogurski at 25:66-26:14. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Lisogurski discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. *See* 11[pre], 11[b], 11[h], 11[i].

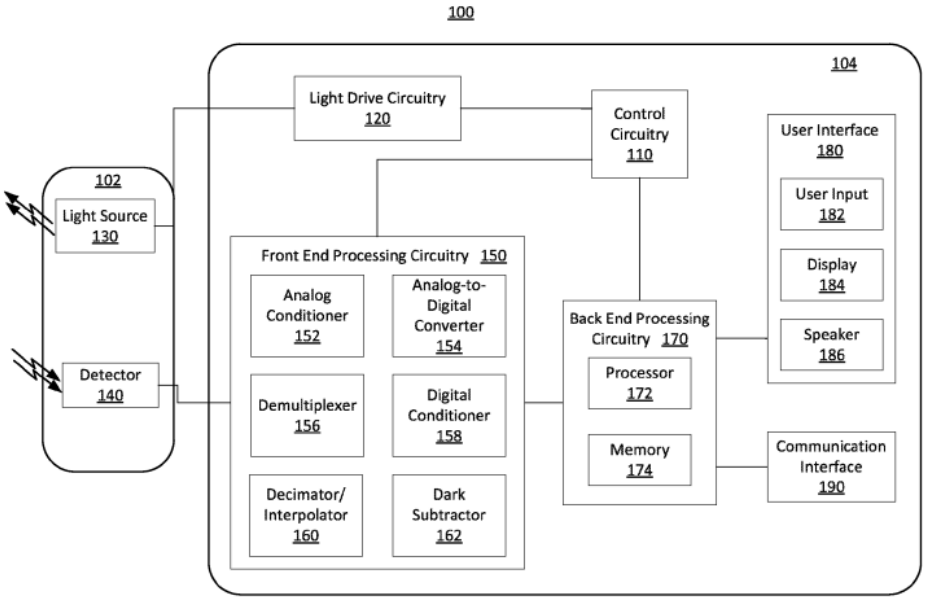
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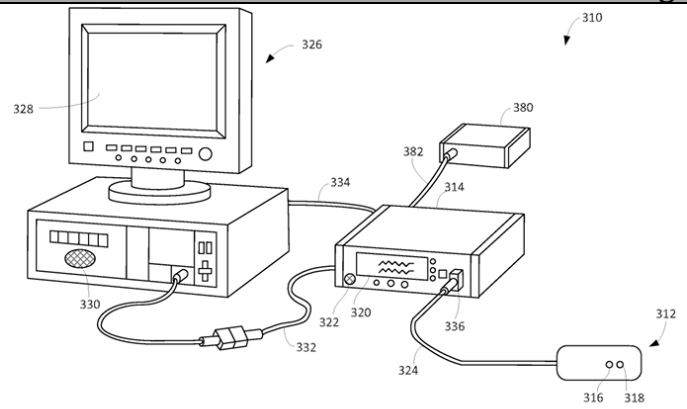
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	 FIG. 1 Lisogurski at Fig. 1. In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a "dark" period, followed by a second light source, followed by a "dark" period. The system may measure the ambient light detected by the detector during the "dark" period and then subtract this ambient contribution from the signals received during the first and second "on" periods. Lisogurski at 6:7-19. In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other suitable reasons, or any combination thereof. The system may receive, for example, an increased level of background noise in the signal due to patient motion. The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio.

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	In some embodiments, the system may increase brightness throughout the cardiac cycle because the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion. In some embodiments, the system may change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light. Lisogurski at 9:46-60. Dark subtractor 162 may operate on the digital signal. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red “on” period 202 may be adjusted by determining the amount of dark signal during the “off” period 220 preceding red “on” period 202. The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red “on” period 202. Alternatively, the “off” period 220 after red “on” period 202 may be used to correct red “on” period 202 rather than the “off” period 220 preceding it. Additionally, an average of the “off” periods 220 before and after red “on” period 202 may be used. Lisogurski at 13:60-14:10. Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Lisogurski at 14:46-55. Region 256 of plot 250 indicates an interval of the timing diagram where both red light modulation 252 and IR light modulation 254 are in an “on” portion of the cardiac cycle modulation. Plot 270 shows an illustrative portion of region 256, where the system is employing a cardiac cycle modulation in addition

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	to the drive cycle modulation. Plot 250 may include a drive cycle modulation technique with a period of time interval 272. The time scale of plot 270 may be significantly shorter than the time scale of plot 250, such that time interval 272 is significantly shorter than time interval 260. For example, time interval 260 (i.e., the period of the cardiac cycle modulation) may be on the order of 1 second, while time interval 272 (i.e., the period of the drive cycle modulation) may be on the order of 1 ms. Time interval 272 may include a sequence of red “on” portion 274, a first “off” portion 276, IR “on” portion 278, and a second “off” portion 280. The first “off” portion 276 and second “off” portion 280 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 274 and IR “on” period 278. Lisogurski at 16:33-53. In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. Lisogurski at 19:20-27. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k]. a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a	Lisogurski discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output

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microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. *See* 11[f].  FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 3 Lisogurski at Fig.3. In some embodiments, reducing power consumption may allow for increased battery life in portable systems or increased portability. Lisogurski at 1:16-18. Back end processing circuitry 170 may include processor 172 and memory 174. Processor 172 may be adapted to execute software, which may include an operating system and one or more applications, as part of performing the functions described herein. Processor 172 may receive and process physiological signals received from front end processing circuitry 150. For example, processor 172 may determine one or more physiological parameters based on the received physiological signals. Memory 174 may include any suitable computer-readable media capable of storing information that can be interpreted by processor 172. This information may bedata or may take the form of computer-executable instruct tions, such as software applications, that cause the microprocessor to perform certain functions and/or computer-implemented methods. Depending on the embodiment, such computer-readable media may include computer storage media and communication media. Computer storage media may include volatile and non-volatile, removable and nonremovable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data.

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	Computer storage media may include, but is not limited to, RAM, ROM, EPROM, EEPROM, flash memory or other solid state memory technology, CD-ROM, DVD, or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by components of the system. Back end processing circuitry 170 may be communicatively coupled with use interface 180 and communication interface 190. User interface 180 may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device. The inputs received by user input 182 can include information about the subject, such as age, weight, height, diagnosis, medications, treatments, and So forth. In an embodiment, the subject may be a medical patient and display 184 may exhibit a list of values which may generally apply to the patient, such as, for example, age ranges or medication families, which the user may select using user input 182. Additionally, display 184 may display, for example, an estimate of a subject’s blood oxygen saturation generated by monitor 104 (referred to as an “SpO2.” measurement), pulse rate information, respiration rate information, blood pressure, any other parameters, and any combination thereof. Display 184 may include any type of display such as a cathode ray tube display, a flat panel display such a liquid crystal display or plasma display, or any other suitable display device. Speaker 186 within user interface 180 may provide an audible sound that may be used in various embodiments, such as for example, sounding an audible alarm in the event that a patient's physiological parameters are not within a predefined normal range. Communication interface 190 may enable monitor 104 to exchange information with external devices. Communications interface 190 may include any suitable hardware, software, or both, which may allow monitor 104 to communicate with electronic circuitry, a device, a network, a server or other workstations, a display, or any combination thereof. Communications interface 190 may include one or more receivers, transmitters, transceivers, antennas, plug-in connectors, ports, communications buses, communications protocols, device identification protocols, any other suitable hardware or software, or any combination thereof. Communications interface 190 may be configured to allow wired communication (e.g., using USB, RS-232 or other standards), wireless communication (e.g., using WiFi, IR, WiMax, BLUETOOTH, UWB, or other standards), or both. For example, communications interface 190 may be configured using a universal serial bus (USB) protocol (e.g., USB 2.0, USB 3.0), and may be configured to couple to other devices (e.g., remote memory devices storing templates) using a four-pin USB standard

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	Type-A connector (e.g., plug and/or socket) and cable. In some embodiments, communications interface 190 may include an internal bus such as, for example, one or more slots for insertion of expansion cards. It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as Such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Lisogurski at 14:56-16:16. FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. System 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two different locations on a subject's body. In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw

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	power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and acoustic detection received from one or more sensor units such as sensor unit 312. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxygenated, and/or total), any other suitable physiological parameters, or any combination thereof. In some embodiments, calculations may be performed on the sensor units or an intermediate device and the result of the calculations may be passed to monitor 314. Further, monitor 314 may include display 320 configured to display the physiological parameters or other information about the system. In the embodiment shown, monitor 314 may also include a speaker 322 to provide an audible sound that may be used in various other embodiments, such as for example, sounding an audible alarm in the event that a subject's physiological parameters are not within a predefined normal range. In some embodiments, the system 310 includes a stand-alone monitor in communication with the monitor 314 via a cable or a wireless network link. In some embodiments, monitor 314 may be implemented as monitor 104 of FIG. 1. In some embodiments, sensor unit 312 may be communicatively coupled to monitor 314 via a cable 324. Cable 324 may include electronic conductors (e.g., wires for transmitting electronic signals from detector 318), optical fibers (e.g., multi-mode or single-mode fibers for transmitting emitted light from light source 316), any other suitable components, any suitable insulation or sheathing, or any combination thereof. In some embodiments, a wireless transmission device (not shown) or the like may be used instead of or in addition to cable 324. Monitor 314 may include a sensor interface configured to receive physiological signals from sensor unit 312, provide signals and power to sensor unit 312, or otherwise communicate with sensor unit 312. The sensor interface may include any suitable hardware, software, or both, which may be allow communication between monitor 314 and sensor unit 312. Calibration device 380, which may be powered by monitor 314, a battery, or by a conventional power source such as a wall outlet, may include any suitable calibration device. Calibration device 380 may be communicatively coupled to monitor 314 via communicative coupling 382, and/or may communicate wirelessly (not shown). In some embodiments, calibration device 380 is completely integrated within monitor 314. In some embodiments, calibration device 380 may include a manual input device (not shown) used by an operator to manually input reference signal measurements obtained from some other source (e.g., an external invasive or non-invasive physiological measurement system).

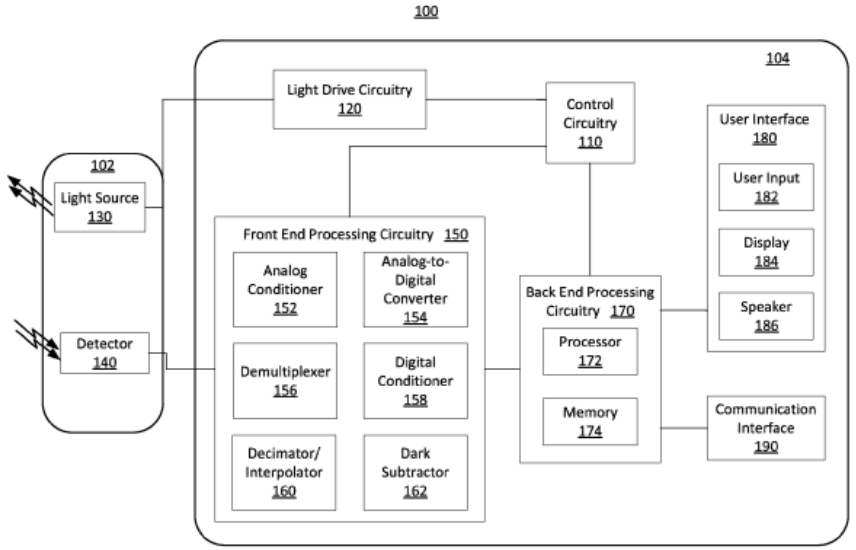
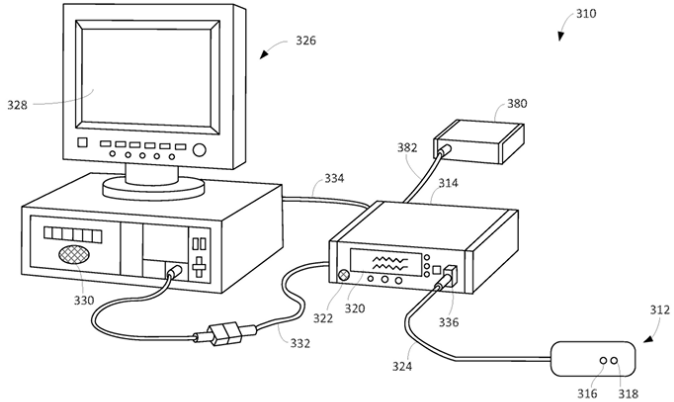
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	In the illustrated embodiment, system 310 includes a multi-parameter physiological monitor 326. The monitor 326 may include a cathode ray tube display, a flat panel display (as shown) such as a liquid crystal display (LCD) or a plasma display, or may include any other type of monitor now known or later developed. Multi-parameter physiological monitor 326 may be configured to calculate physiological parameters and to provide a display 328 for information from monitor 314 and from other medical monitoring devices or systems (not shown). For example, multi-parameter physiological monitor 326 may be configured to display an estimate of a subject's blood oxygen saturation and hemoglobin concentration generated by monitor 314. Multi-parameter physiological monitor 326 may include a speaker 330. Monitor 314 may be communicatively coupled to multi-parameter physiological monitor 326 via a cable 332 or 334 that is coupled to a sensor input port or a digital communications port, respectively and/or may communicate wirelessly (not shown). In addition, monitor 314 and/or multi-parameter physiological monitor 326 may be coupled to a network to enable the sharing of information with servers or other workstations (not shown). Monitor 314 may be powered by a battery (not shown) or by a conventional power source such as a wall outlet. In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. In some embodiments, any of the processing components and/or circuits, or portions thereof, of FIGS. 1 and 3 may be referred to collectively as processing equipment. For example, processing equipment may be configured to generate light drive signals, amplify, filter, sample and digitize detector signals, and calculate physiological information from the digitized signal. In some embodiments, all or some of the components of the processing equipment may be referred to as a processing module. Lisogurski at 17:30-19:12 The system may display the determined physiological parameter using a local display (e.g., display 320 of FIG. 3 or display 328 of FIG. 3), display them on a remote display, publish the data to a server or website, make the parameters available to a user by any other suitable technique, or any combination thereof. Lisogurski at 20:55-60.

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	The system may determine the timing of the diastole periods using historical information from previous cardiac cycles, from an external sensor, from user input, from measurements made with a different cardiac cycle modulation, by any other suitable technique, or any combination thereof. Lisogurski at 27:31-36. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Lisogurski discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. *See* 11[k].

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	 FIG. 1 Lisogurski at Fig. 1.  FIG. 3 Lisogurski at Fig.3.

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	FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Lisogurski at 10:42-47. In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:9-27. In the embodiment shown, monitor 104 includes control circuitry 110, light drive circuitry 120, front end processing circuitry 150, back end processing circuitry 170, user interface 180, and communication interface 190. Monitor 104 may be communicatively coupled to sensor 102. Lisogurski at 11:28-32. For example, processor 172 may determine one or more physiological parameters based on the received physiological signals. Lisogurski at 14:62-64.

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	Communication interface 190 may enable monitor 104 to exchange information with external devices. Communications interface 190 may include any suitable hardware, software, or both, which may allow monitor 104 to communicate with electronic circuitry, a device, a network, a server or other workstations, a display, or any combination thereof. Communications interface 190 may include one or more receivers, transmitters, transceivers, antennas, plug-in connectors, ports, communications buses, communications protocols, device identification protocols, any other suitable hardware or software, or any combination thereof. Communications interface 190 may be configured to allow wired communication (e.g., using USB, RS-232 or other standards), wireless communication (e.g., using WiFi, IR, WiMax, BLUETOOTH, UWB, or other standards), or both. For example, communications interface 190 may be configured using a universal serial bus (USB) protocol (e.g., USB 2.0, USB 3.0), and may be configured to couple to other devices (e.g., remote memory devices storing templates) using a four-pin USB standard Type-A connector (e.g., plug and/or socket) and cable. In some embodiments, communications interface 190 may include an internal bus such as, for example, one or more slots for insertion of expansion cards. Lisogurski at 15:43-65. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxygenated, and/or total), any other suitable physiological parameters, or any combination thereof. Lisogurski at 17:62-67. Multi-parameter physiological monitor 326 may be configured to calculate physiological parameters and to provide a display 328 for information from monitor 314 and from other medical monitoring devices or systems (not shown). For example, multi-parameter physiological monitor 326 may be configured to display an estimate of a Subject’s blood oxygen Saturation and hemoglobin concentration generated by monitor 314. Multi-parameter physiological monitor 326 may include a speaker 330. Monitor 314 may be communicatively coupled to multiparameter physiological monitor 326 via a cable 332 or 334 that is coupled to a sensor input port or a digital communications port, respectively and/or may communicate wirelessly (not shown). In addition, monitor 314 and/or multi-parameter physiological monitor 326 may be coupled to a network to enable the sharing of information with servers or other work stations (not shown). Monitor 314 may be powered by a battery (not shown) or by a conventional power source Such as a wall outlet.

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	Lisogurski at 18:49-65. In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. In some embodiments, any of the processing components and/or circuits, or portions thereof, of FIGS. 1 and 3 may be referred to collectively as processing equipment. For example, processing equipment may be configured to generate light drive signals, amplify, filter, sample and digitize detector signals, and calculate physiological information from the digitized signal. In some embodiments, all or some of the components of the processing equipment may be referred to as a processing module. FIG. 4 is flow diagram 400 showing illustrative steps for determining a physiological parameter in accordance with some embodiments of the present disclosure. In some embodiments, the system may emit a photonic signal from a first light source and use information from the related attenuated signal to generate a light drive signal for a second light source. Lisogurski at 19:1-19. Other information may include, for example, historical analysis of prior cardiac cycles and information from external sensors. For example, the system may determine an average pulse period from a number of prior pulse cycles. Statistical information Such as the standard deviation may also be calculated to in part determine a confidence parameter for the historical information. Lisogurski at 20:7-13. The physiological parameter may be determined using any suitable hardware technique, software technique, or combination thereof. In some embodiments, processing equipment remote to the system may be used to determine physiological parameters. The system may display the deter mined physiological parameter using a local display (e.g., display 320 of FIG.3 or display 328 of FIG.3), display them on a remote display, publish the data to a server or website, make the parameters available to a user by any other suitable technique, or any combination thereof. Lisogurski at 26:51-60.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre]. The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lisogurski discloses or renders obvious the measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. In some embodiments, the system may vary the algorithm used to determine a physiological parameter based, in part, on the cardiac cycle modulation technique. For example, if a cardiac cycle modulation technique only detects the peaks and valleys of a pulse cycle, a first type of blood oxygen saturation algorithm may be used (e.g., discrete oximetry based only on the peak and valley information). If the cardiac cycle modulation technique detects the entire pulse, a different blood oxygen saturation detection algorithm may be used (e.g., a regression based algorithm). In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other Suitable reasons, or any combination thereof. The system may receive, for example, an increased level of background noise in the signal due to patient motion. The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio. Lisogurski at 9:36-52. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Lisogurski discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. In some embodiments, the system may vary the algorithm used to determine a physiological parameter based, in part, on the cardiac cycle modulation technique. For example, if a cardiac cycle modulation technique only detects the peaks and valleys of a pulse cycle, a first type of blood oxygen saturation algorithm may be used (e.g., discrete oximetry based only on the peak and valley information). If the cardiac cycle modulation technique detects the entire pulse, a different blood oxygen saturation detection algorithm may be used (e.g., a regression based algorithm). In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other Suitable reasons, or any combination thereof. The system may receive, for example, an increased level of background noise in the signal due to patient motion. The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio. Lisogurski at 9:36-52. In some embodiments, the blood oxygen saturation may be compared to a threshold or target value. Such as threshold 830. For example, threshold 830 may be approximately 70-80% of maximum blood oxygen saturation. During time interval 824, when the SpO2 signal is greater than threshold 830, the system may operate in a first mode. For example, as illustrated, the system may use IR light drive signal 840 to monitor cardiac activity throughout a cardiac pulse cycle, and may modulate red light drive signal 838 accordingly. At time point 826, SpO2 signal may cross threshold 830 at point 834. In some embodiments, this may be indicative of decreasing blood oxygen saturation. During time interval 828 following time point 826, the system may operate in a second mode. For example, as illustrated, the system may use red light drive signal 838 to monitor cardiac activity throughout a cardiac pulse cycle, and may modulate IR light drive signal 840 accordingly. Lisogurski at 24:41-57.

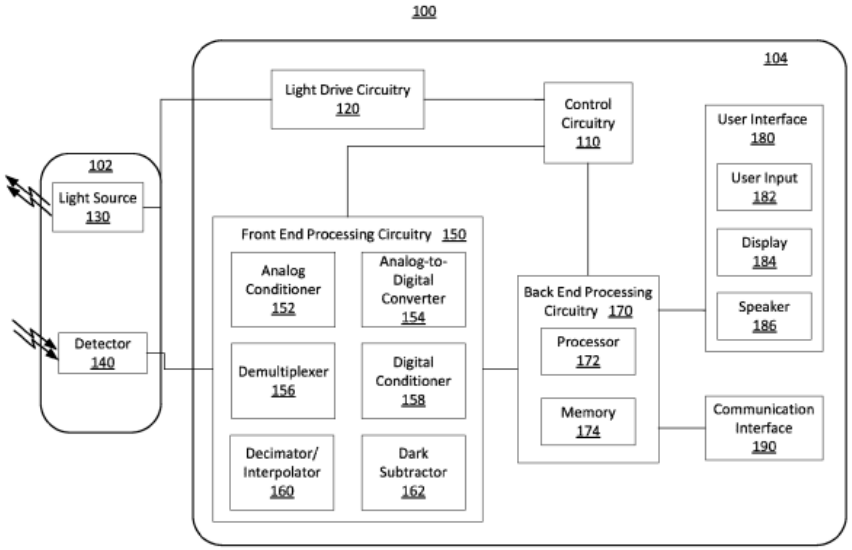
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	For example, the system may detect a change in background noise, a change in ambient light, a change in the available power, other suitable changes, or any combination thereof. In some embodiments, an increase in the number of identified fiducial points (e.g., zero crossings of the derivatives) may cause the system to vary drive signals. In step 1906, the system may perform a physiological measurement in a second mode. Lisogurski at 37:8-14. FIG. 25 is another illustrative plot 2500 of a waveform showing identification of fiducials in accordance with some embodiments of the present disclosure. In some embodiments, the system may use non-zero threshold crossings to identify a region of interest surrounding a fiducial or other point of interest. In some embodiments, the system may turn on a light source before a desired point of interest and turn off a light Source following a point of interest so that the photonic signal can stabilize, so that the detector can stabilize, so that the processing equipment can obtain extra samples for averaging, interpolating, or decimating, for any other suitable reason, for amplifier gain adjustments to stabilize, or any combination thereof. In some embodiments, the system may use historical information from previous pulse cycles in determining thresholds. In some embodiments, the system may collect data without using cardiac cycle modulation until enough information is collected to determine thresholds and other alignment information for cardiac cycle modulation. In some embodiments, the system may adjust thresholds using historical information from previous cardiac cycle modulated pulse cycles. In some embodiments, the system may determine ensemble averages of previous pulse cycles. In some embodiments, the system may use multiple thresholds depending on the period of interest, the light source, the cardiac cycle modulation, the drive cycle modulation, convention servo algorithms, other suitable criteria, or any com bination thereof. In some embodiments, the system may use the shape, slope, trend, derivatives, other suitable information, and any combination thereof, to determine parameters for cardiac cycle modulation (e.g., emitter brightness). Plot 2500 may include waveform 2502 and derivative 2504. Thresholds may include Zero threshold 2506, positive threshold 2508, and negative threshold 2510. In some embodiments, the positive and negative threshold offsets from Zero may or may not be equal. In some embodiments, the offsets may be determined by user input, by predetermined values, by processing of previous data, by system settings

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	related to the sensor and detector, by System settings related to the physiological parameter determined, by any other suitable parameters, or any combination thereof. The system may identify threshold crossings of derivative 2504. For example, the system may identify positive thresh old crossing 2512, Zero threshold crossing 2516, and negative threshold crossing 2518. The system may use these points to determine light drive signals, to vary cardiac cycle modulation, to vary any other Suitable parameters, or any combination thereof. The system may correlate threshold crossings with points on waveform 2502, for example, correlating positive threshold crossing 2512 with point 2520. Zero threshold crossing 2516 with point 2422, and negative threshold crossing 2518 with point 2524. For example, in an embodiment described by flow diagram 400 of FIG. 4, where a second photonic signal is controlled using in part information deter mined by a first photonic signal, positive threshold crossing 2512 may be used as a turn on point for the second photonic signal and negative threshold crossing 2518 may be used as a turn off point for the second photonic signal. The system would thus sample waveform 2502 from point 2520 to 2524 (i.e., segment 2526) with, for example, the second photonic signal. In some embodiments, information related to threshold crossings may be used to determine other information related to waveform 2502. For example, the order of positive and negative threshold crossings of a first derivative may be used to identify a related Zero crossing as a local maximum or minimum. Lisogurski at 40:42-41:39. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b]. wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the	Lisogurski discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.

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measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	 FIG. 1 Lisogurski at Fig. 1. The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. The system may include, for example, a light source and a photosensitive detector. Lisogurski at 3:43-46. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs. In some applications, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Red and infrared (IR) wave lengths may be used because it has been observed that highly oxygenated blood will absorb relatively less red light and more IR light than blood with a lower oxygen

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	saturation. By comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen saturation of hemoglobin in arterial blood. The system may process data to determine physiological parameters using techniques well known in the art. For example, the system may determine blood oxygen saturation using two wavelengths of light and a ratio-of-ratios calculation. The system also may identify pulses and determine pulse amplitude, respiration, blood pressure, other suitable parameters, or any combination thereof, using any suitable calculation techniques. In some embodiments, the system may use information from external sources (e.g., tabulated data, secondary sensor devices) to determine physiological parameters. Lisogurski at 4:36-62. In some embodiments, the system may vary the algorithm used to determine a physiological parameter based, in part, on the cardiac cycle modulation technique. For example, if a cardiac cycle modulation technique only detects the peaks and valleys of a pulse cycle, a first type of blood oxygen saturation algorithm may be used (e.g., discrete oximetry based only on the peak and valley information). If the cardiac cycle modulation technique detects the entire pulse, a different blood oxygen saturation detection algorithm may be used (e.g., a regression based algorithm). Lisogurski at 9:36-45. In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other suitable reasons, or any combination thereof. The system may receive, for example, an increased level of background noise in the signal due to patient motion. The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio. In some embodiments, the system may increase brightness throughout the cardiac cycle because the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion. In some embodiments, the system may change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light. Lisogurski at 9:46-60.

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	FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Lisogurski at 10:42-47. In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:9-27. In an embodiment, the subject may be a medical patient and display 184 may exhibit a list of values which may generally apply to the patient, Such as, for example, age ranges or medication families, which the user may select using user input 182. Lisogurski at 15:26-30. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart.

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	Lisogurski at 17:35-45. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Lisogurski discloses or renders obvious the measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. The system may, in response to the external trigger, vary the light intensity, duty cycle, light source firing rate, any other Suitable parameter, or any combination thereof. Lisogurski at 1:67-2:3. In some embodiments, conventional servo algorithms may be used in addition to any combination of cardiac cycle modulation and drive cycle modulation. Conventional servo algorithms may adjust the light drive signals due to, for example, ambient light changes, emitter and detector spacing changes, sensor positioning, other Suitable parameters, or any combination thereof. Generally, conventional servo algorithms vary parameters at a slower rate than cardiac cycle modulation. For example, a conventional servo algorithm may adjust drive signal brightness due to ambient light every several seconds. The system may use conventional servo algorithms in part to keep received signal levels within the range of an analog to digital converter's dynamic range. For example, a signal with amplitudes that are large may saturate an analog to digital convertor. In response to a signal with high amplitudes, the system may reduce emitter brightness. In a further example, the quality of a low amplitude signal may be degraded by quantization noise by an analog to digital converter. In response, the system may increase the emitter brightness.

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	Lisogurski at 5:55-6:6. As used herein, the terms “on” and “off” are merely exemplary and may not necessarily refer to a fully on or off state. For example, “on” and “off” may refer to switching power or other components, high and low brightness output states, high and low values within a continuous modulation, high and low values of electrical current provided to an emitter, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitteris switched on), any other suitable relatively distinct states, or any combination thereof. In some embodiments, “on” and “off” states may relate to high and low values of a variable that varies with multiple discrete steps. For example, an emitter brightness may be provided by the system as off, low, medium, and high. In this example, an “off” state may refer to off or low emission and “on” may refer to medium or high. In another example, “off may refer to an off state and “on” may refer to a low, medium, or high output depending on a second input or system variable. Lisogurski at 8:27-44. In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other suitable reasons, or any combination thereof. The system may receive, for example, an increased level of background noise in the signal due to patient motion. The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio. In some embodiments, the system may increase brightness throughout the cardiac cycle because the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion. In some embodiments, the system may change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light. Lisogurski at 9:46-60. For example, frontend processing circuitry 150 may synchronize the operation of an analog to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. Lisogurski at 11:43-46. The light drive signal may, for example, control the intensity of light source 130 and the timing of when light source 130 is turned on and off. When light source 130 is configured to emit two or more wave

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	lengths of light, the light drive signal may be configured to control the operation of each wavelength of light. Lisogurski 11:52-57. In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. Lisogurski at 19:20-27. In step 404, the system may receive a light signal. The light may be received using a sensor, for example, detector 140 of FIG. 1 or detector 318 of FIG. 3. The light signal may be attenuated by the subject. The received light signal may in part include light from the first photonic signal. For example, the system may emit light that is reflected by the subject or transmitted through the subject. The interaction of the emitted light with the subject may cause the light to become attenuated. In some embodiments, the attenuation of the light may depend on the wavelength of the light and the tissue with which the light interacts. For example, particular wavelengths of light may be attenuated more strongly by oxyhemoglobin than other wavelengths. In some embodiments, the system may amplify the received signal using front end processor circuitry. In some embodiments, the gain may be modulated using a technique correlated to the cardiac cycle modulation. The gain of the amplifier may be adjusted based on the emitted light brightness, historical information related to the brightness of prior received attenuated signals, other suitable information, or any combination thereof, so that the amplified signal matches the range of the analog-to-digital converter and thus increases resolution. In some embodiments, the system may account for the gain using hardware, software, or any combination thereof, such that the original intensity information is retained. Lisogurski at 19:40-64. The system may generate the light drive signal such that a parameter of the emitted one or more photonic signals varies substantially synchronously with physiological pulses of the subject. For example, the system may generate a light drive signal that varies with a period the same as or closely related to the

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	period of the cardiac cycle, thus generating a cardiac cycle modulation. The system may vary parameters related to the light drive signal including drive current or light bright ness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof. In some embodiments, the system may use a cardiac cycle modulation that spans several cardiac cycles (e.g., emitting light from a light source during the first one of every five cycles). In some embodiments, the system may generate a light drive signal that modulates parameters of more than one light source using more than one modulation technique. It will be under stood that the system may apply this cardiac cycle modulation to the light drive signal in addition to a drive cycle modulation, as illustrated in FIG. 2C, and conventional servo algorithms. In some embodiments, physiological pulses may be cardiac pulses, respiratory pulses, muscular pulses, any other suitable pulses, or any combination thereof. Where physiological pulses are respiratory pulses, they may relate to respiration rate, inspiration, expiration, ventilator parameters, changes in a respiratory pressure signals, any other suitable parameter, or any combination thereof. In some embodiments, particular segments of a respiratory cycle may provide an increased signal to noise ratio, increased signal strength, increased physiological parameter accuracy, increased physiological parameter precision, any other suitable parameters, or any combination thereof. In some embodiments, respiration may cause variations in photoplethysmography data, and thus it may be desired to correlate a modulation technique with respiration variations or both respiration variations and cardiac pulses. Lisogurski at 25:46-26:14. In step 904, the system may receive a light signal. The light may be received using a sensor, for example, detector 140 of FIG. 1 or detector 318 of FIG. 3. The light signal may be attenuated by the subject. Lisogurski at 26:26-29. It will also be understood that modulation of the light drive signal (i.e., the “on” and "off states illustrated by light drive signal 1010) is merely exemplary and may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof. It will also be under stood that the “on” and “off states are merely exemplary and that the system may use any suitable variations of discrete and/or continuous modulations. For example, discrete modulations may include drive signals with one or more step functions. Continuous modulations may include sinusoidal waveforms.

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	Lisogurski at 27:44-55. The system may vary the light drive signal in a way correlated to the cardiac pulse signal of the Subject. The system may generate an “on” light drive signal during one or more cardiac cycles and an "off light drive signal during one or more cardiac cycles. For example, the system may generate an “on” light drive signal during period 1420 concurrent with pulse cycle 1406, an “off light drive signal during pulse cycles 1408 and 1410, an “on” light drive signal during period 1422 concurrent with pulse cycle 1412, an “off light drive signal during pulse cycles 1414 and 1416, and an “on” light drive signal during period 1424 concurrent with pulse cycle 1418. It will be understood that this particular modulation is merely exemplary and that any suitable inter-cycle modulation may be used. In some embodiments, the system may use an intra-cardiac cycle modulation as described above during “on” periods 1420, 1422, and 1424 of the inter-cardiac cycle modulation illustrated in timing diagram 1400. For example, the system may emit light during any suitable intra-cycle period (e.g., systole period, diastole period, peak, etc.) of pulse cycle 1406, 1412, and 1418, as described in flow diagram 900 of FIG.9. In some embodiments, the system may emit light from a first light source during the “off cardiac cycles and emit light from a second light source during the “on” periods (or a portion of the “on” periods), such that information related to the first light source is used to determine when to generate the second light drive signal as described in flow diagram 400 of FIG. 4. The system may determine the timing of the cardiac cycles using historical information from previous cardiac cycles, from an external sensor, from user input, from measurementsmade with a different cardiac cycle modulation, by any other suitable technique, or any combination thereof. It will be understood that the system may align modulation with pulses of the heart, pulses of aparticular muscle group, other suitable pulses, any other suitable physiological function, or any combination thereof. It will also be understood that modulation of the light drive signal (i.e., the “on” and “off” states illustrated by light drive signal 1110) is merely exemplary and may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof. It will also be understood that the “on” and “off” states are merely exemplary and that the system may use any suitable number of discrete or continuous modulation variations. Lisogurski at 31:11-55.

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	In some embodiments, sampling rate modulation may be correlated with light drive signal modulation. Varying the sampling rate may reduce power consumption by reducing emitter drive time and lowering utilization of an analog-to-digital converter. In some embodiments, varying the sampling rate may increase the time resolution of identified features. For example, in a continuous non-invasive blood pressure measurement where the pulse transit time is used in calculations, increasing the sampling rate for a portion of the cardiac cycle may result in more accurate and reliable physiological information. In another example, varying the sampling rate around a cardiac pulse cycle feature. Such as a peak or notch, may increase the accuracy of determining the location of that feature in time. In some embodiments, lower frequency or less critical parts of the cardiac pulse cycle may be sampled at a lower rate while maintaining highly accuracy and reliable physiological parameter determination. In step 1702, the system may receive a signal. The signal may be sampled at a first rate. The signal may be sampled using an analog-to-digital converter in the front end processing circuitry. Lisogurski at 33:47-34:1. It will also be understood that the earlier described embodiments relating to varying light output may also apply to sampling rate. In some embodiments, the sampling rate may represent the number of samples taken during an “on” period of the drive cycle modulation. For example, an “on” period may be “on” period 202 of FIG. 2A. The system may sample that drive cycle modulation “on” period a lower number of times at a low sampling rate, and a greater number of times at a high sampling rate. In this embodiment, the firing rate of the emitters may not be modulated along with the analog-to-digital sampling rate. For example, at a low sampling rate, the system may sample once per “on” period, while at a high sampling rate the system may take several samples per “on” period and average them. In some embodiments, averaging multiple samples for the same “on” period may include oversampling techniques. In some embodiments, the sampling rate may represent the amount of time between “on” periods. For example, the time between “on” periods may be the length of time of “off period 220 of FIG. 2A. Increasing the duration of the “off periods (i.e., decreasing the emitter firing rate) relates to a decreased sampling rate. Similarly, decreasing the duration of the “off periods (i.e., increasing the emitter firing rate) relates to an increased sampling rate.

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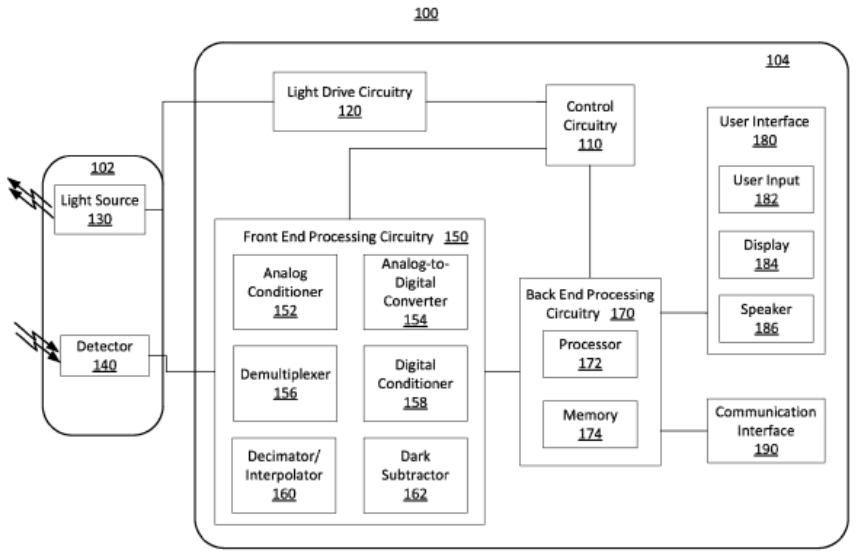
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	Lisogurski at 35:7-31. In some embodiments, the system may detect a condition where a second mode is required that is not related to a physiological condition. For example, the system may detect a change in background noise, a change in ambient light, a change in the available power, other suitable changes, or any combination thereof. In some embodiments, an increase in the number of identified fiducial points (e.g., zero crossings of the derivatives) may cause the system to vary drive signals. In step 1906, the system may perform a physiological measurement in a second mode. For example, the system may stop cardiac cycle modulation and emit light at a constant brightness. In a further example, the system may increase the emitter intensity used in a cardiac cycle modulation. In a further example, the system may lengthen the “on” periods of a cardiac cycle modulation. In a further example, the system may alter the cardiac cycle modulation technique as described above with relation to FIG. 8B. Lisogurski at 37:6-22. FIG. 26 is illustrative plot 2600 of waveforms showing pulse identification in accordance with some embodiments of the present disclosure. Plot 2600 may include PPG signal 2602, systole period modulated PPG signal 2604, and diastole period modulated PPG signal 2606. Plot 2600 may be shown with arbitrary units on the ordinate axis and time on the abscissa. The signals shown in plot 2600 are simulated saw tooth-shaped 60 BPMIR waveforms with a moderate amount of noise (e.g., Gaussian noise from approximately 0-5 HZ with amplitude independent of emitter output). The signals provide examples that illustrate when cardiac cycle modulation is properly selected, the accuracy of monitoring functions can be enhanced. The circles shown in plot 2600 indicate the occurrence of local minima and maxima using, for example, a roughly 150 ms window centered on each sample. PPG signal 2602 may be representative of a PPG signal determined using a fixed power output throughout the cardiac cycle. Identified local maximum 2608 and local minimum 2610 are representative of a correctly identified peak and valley of physiological pulse in PPG signal 2602. The identified local maximum and minimum in region 2611 are representative of noise and do not correctly identify the peak and valley of a physiological pulse. Systole period modulated PPG signal 2604 may be representative of a PPG signal determined using a cardiac cycle modulation, where the light Source is modulated with a sinusoidal waveform that varies the brightness of the emitter from 50-150% of the mean. The peak emitter output is centered during the

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	systole period of the cardiac cycle. For example, the light drive signal may drive an IR modulated LED using sinusoidal cardiac cycle modulation where peak LED output occurs during systole. In a further example, the cardiac cycle modulations may relate to cardiac cycle modulations illustrated in plot 500 of FIG.5 and plot 1100 of FIG. 11. Identified local maximum 2614 and local minimum 2612 are representative of a correctly identified peak and valley of a physiological pulse. The identified maxima and minima in, for example, regions 2616 and 2618 are representative of noise and do not correctly identify the peak and valley of a physiological pulse. Because systole period modulated. PPG signal 2604 uses lower power during the diastole portion of the cardiac cycle, noise may have a greater influence and cause spurious local maxima and minima to appear in the diastole portion of signal 2604. In some embodiments, the increased effect of noise during the diastole portions may reduce the accuracy or reliability of a pulse determination. Diastole period modulated PPG signal 2606 may be representative of a PPG signal determined using a cardiac cycle modulation, where the light source is modulated with a sinusoidal waveform that varies the brightness of the emitter from 50-150% of the mean. The peak emitter output is centered during the diastole period of the cardiac cycle. For example, the light drive signal may drive an IR modulated LED using sinusoidal cardiac cycle modulation where peak LED output occurs during diastole. In a further example, the cardiac cycle modulations may relate to cardiac cycle modulations illustrated in plot 600 of FIG. 6 and plot 1000 of FIG. 10. Identified local maximum 2620 and local minimum 2622 are representative of a correctly identified peak and valley of a physiological pulse. Diastole period modulated PPG signal 2606, however, does not include any spurious local maxima and minima due to noise. For example, region 2624 of diastole period modulated PPG signal 2606 does not include a spurious local maximum and minimum whereas corresponding region 2616 of systole period modulated PPG signal 2604 includes a spurious local maximum and minimum. In view of the foregoing, for pulse identification techniques in the presence of moderate noise, the diastole period cardiac cycle modulation technique may provide improved performance. For example, diastole period cardiac modulation may result in reduced identification of spurious pairs of incorrectly identified local maxima and minima. Pulse amplitude and variations thereofare common calculations in physiological monitors. The simulated waveforms of plot 2600 of FIG. 26 may be used to calculate pulse amplitudes (i.e., the differences between maxima and minima). The calculations may be computed on the maxima and minima of correctly identified pulses. Based on this analysis, it may be determined that noise contributes

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	coefficients of variation of 2.6%, 1.9%, and 3.8% to the computed pulse amplitudes of PPG signal 2602, systole period modulated PPG signal 2604, and diastole period modulated PPG signal 2606, respectively. Accordingly, for pulse amplitude calculation techniques in the presence of moderate noise, the systole period cardiac cycle modulation technique may provide improved performance. Lisogurski at 41:40-42:58. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Lisogurski discloses or renders obvious the measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11, 11[a], 11[e] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	

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15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Lisogurski discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above.  FIG. 1 Lisogurski at Fig. 1. The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. The system may include, for example, a light source and a photosensitive detector. Lisogurski at 3:43-46.

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	Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Lisogurski at 10:48-64. In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:9-27. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart.

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	Lisogurski at 17:35-45. In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulation. For example, the first light drive signal may be configured to activate one LED to emit a photonic signal and not activate other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated. Lisogurski at 19:20-39. In step 1702, the system may receive a signal. The signal may be sampled at a first rate. The signal may be sampled using an analog-to-digital converter in the front end processing circuitry. For example, an attenuated light signal may be converted to an analog electronic signal by a detector. The analog electronic signal may be converted to a digital signal at a particular rate by an analog to digital converter, such that at each sampling point the converter determines the amplitude of the analog signal (e.g., current or voltage) and outputs a digital word related to that amplitude. The rate at which sampling occurs may be controlled by, for example, a timing control signal (e.g., provided by control circuitry 110 of FIG. 1). In some embodiments, the sampling rate may represent the number of samples taken during an “on” period of the drive cycle modulation. In some embodiments, the sampling rate may represent the amount of time between “on” periods. Lisogurski at 33:65-34:13. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Lisogurski discloses or renders obvious the measurement system of claim 15, wherein the first arc and the second arc are concentric. *See* claim 15 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lisogurski discloses or renders obvious a wearable device for use with a smart phone or tablet, the wearable device. *See* 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source	Lisogurski discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters.

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comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	*See* 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Lisogurski discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths. *See* 19[a], 11[a], 11[b]. FIG. 2A shows an illustrative plot of a light drive signal including red light “on” period 202 and IR light "on period” 204 in accordance with some embodiments of the present disclosure. Light “on” periods 202, and 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, “on” and “off” may refer to switching power or other components, high and low output states, high and low values within a continuous modulation, high and low duty cycles, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red “on” period 202 and IR “on” period 204 to drive red and IR light emitters, respectively, within light source 130. Red “on” period 202 may have a higher amplitude than IR “on” period 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue at certain oxygen Saturations. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a Subject in order generate physiological signals that physiological monitoring system 100 may process to calclate physiological paramters. Lisogurski at 11:61-12:16.

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	In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulation. For example, the first light drive signal may be configured to activate one LED to emit a photonic signal and not activate other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated. Lisogurski at 19:20-39. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Lisogurski discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 19[a], 11[c], 11[e]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;	Lisogurski discloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue. *See* 19[a], 11[d], 11[h], 11[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Lisogurski discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d]. FIG. 2A shows an illustrative plot of a light drive signal including red light “on” period 202 and IR light "on period” 204 in accordance with some embodiments of the present disclosure. Light “on” periods 202, and 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, “on” and “off” may refer to switching power or other components, high and low output states, high and low values within a continuous modulation, high and low duty cycles, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red “on” period 202 and IR “on” period 204 to drive red and IR light emitters, respectively, within light source 130. Red “on” period 202 may have a higher amplitude than IR “on” period 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue at certain oxygen Saturations. When the red and IR light sources are driven in this manner

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	they emit pulses of light at their respective wavelengths into the tissue of a Subject in order generate physiological signals that physiological monitoring system 100 may process to calclate physiological paramters. Lisogurski at 11:61-12:16. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Lisogurski discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* 19[a], 11[a], 11[i], 11[j]. In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the ambient light detected by the detector during the “dark” period and then subtract this ambient contribution from the signals received during the first and second “on” periods. Lisogurski at 6:7-19. Dark subtractor 162 may operate on the digital signal. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak. For example, in reference to FIG. 2A, a detection signal peak

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	corresponding to red “on” period 202 may be adjusted by determining the amount of dark signal during the “off” period 220 preceding red “on” period 202. The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red “on” period 202. Alternatively, the “off” period 220 after red “on” period 202 may be used to correct red “on” period 202 rather than the “off” period 220 preceding it. Additionally, an average of the “off” periods 220 before and after red “on” period 202 may be used. Lisogurski at 13:60-14:10. Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Lisogurski at 14:46-55. Region 256 of plot 250 indicates an interval of the timing diagram where both red light modulation 252 and IR light modulation 254 are in an “on” portion of the cardiac cycle modulation. Plot 270 shows an illustrative portion of region 256, where the system is employing a cardiac cycle modulation in addition to the drive cycle modulation. Plot 250 may include a drive cycle modulation technique with a period of time interval 272. The time scale of plot 270 may be significantly shorter than the time scale of plot 250, such that time interval 272 is significantly shorter than time interval 260. For example, time interval 260 (i.e., the period of the cardiac cycle modulation) may be on the order of 1 second, while time interval 272 (i.e., the period of the drive cycle modulation) may be on the order of 1 ms. Time interval 272 may include a sequence of red “on” portion 274, a first “off” portion 276, IR “on” portion 278, and a second “off” portion 280. The first “off” portion 276 and second “off” portion 280 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 274 and IR “on” period 278. Lisogurski at 16:33-53.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Lisogurski discloses or renders obvious increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Lisogurski discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or	Lisogurski discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen.

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tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	*See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link.	Lisogurski discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of	Lisogurski disclosesor renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claims 13, 19 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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semiconductor sources from an initial non-zero pulse rate.	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Lisogurski discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claims 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Lisogurski discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claims 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D9

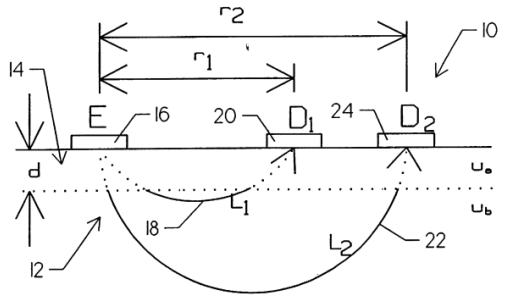
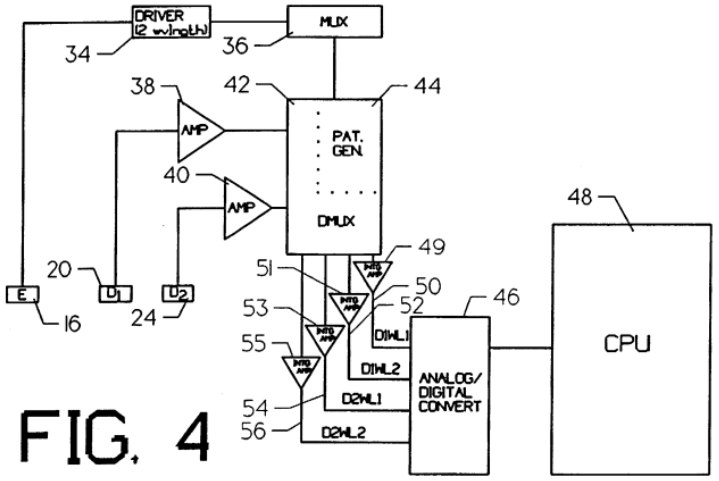
U.S. Pat. No. 10,874,304 in view of U.S. Patent No. 5,746,206 to Paul D. Mannheimer ("Mannheimer")

As described in detail below, Mannheimer (individually or collectively) anticipates and/or renders obvious claims 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D8 and D10-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. . This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Mannheimer. The cited portions of Mannheimer are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Mannheimer. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Mannheimer "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Mannheimer does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Mannheimer (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Mannheimer anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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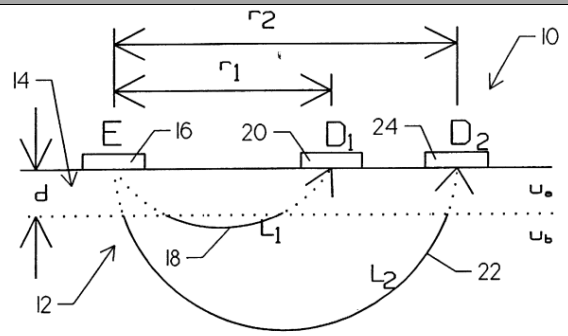
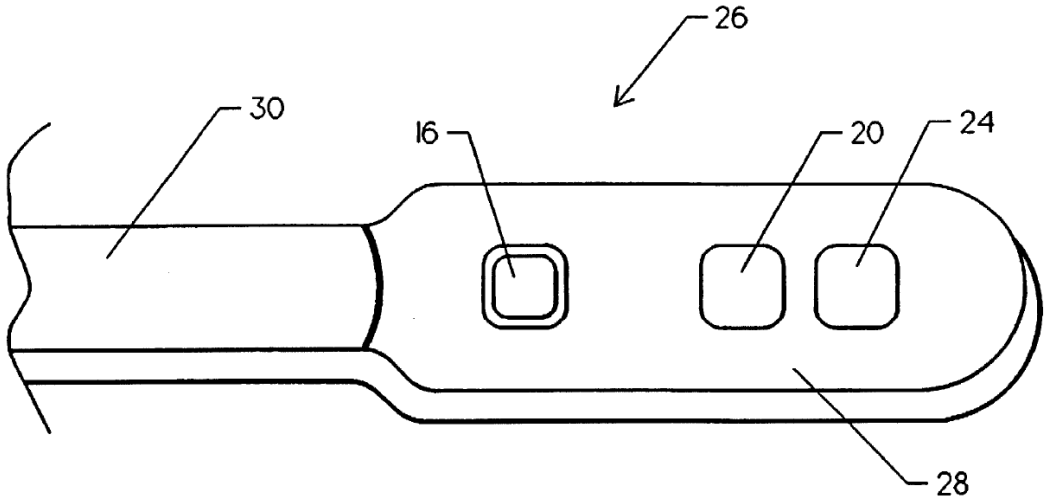
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Claim 1	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mannheimer discloses or renders obvious a measurement system.  FIG. 1 A Mannheimer at Fig. 1A.  FIG. 4

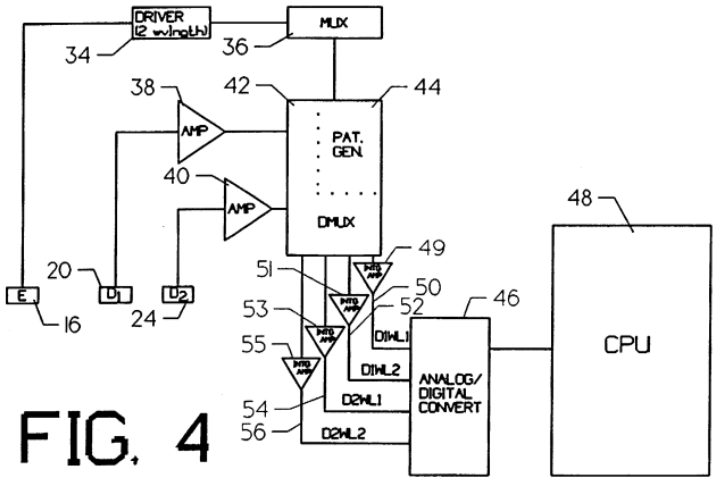
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	Mannheimer at Fig. 4. An apparatus of and method for measuring arterial blood oxygen saturation at a particular tissue level of interest. Visible and near infrared radiation is emitted into a patient at the measurement site using two different wavelengths. Detection at two different detection sites permits rejection of oxygen saturation at undesired tissue levels. Mannheimer at [Abstract] Specifically, the present invention allows for pulsed oximetry measurement which isolates arterial saturation levels for particular ranges of tissue layers which rejects saturation levels of the tissue above or below the tissue of interest by utilizing multiple spaced detectors and/or emitters. Mannheimer at 2:1-6. FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 2:66-3:9. F1G. 2 is a perspective view of the preferred mode of patient interface device 26 employing the present invention. Planar surface 28 is placed into contact with the skin of the patient during monitoring and measurement. If desirable, this position may be maintained via adhesive or other mechanical means known in the art. Further. if desirable, surface 28 may have a curvature, and may be either flexible or rigid. Mannheimer at 5:63-6:3.

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	FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. Mannheimer at 6:17-32. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Mannheimer discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths.

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	 FIG. 1 A Mannheimer at Fig. 1A.  FIG. 2 Mannheimer Fig. 2

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	 FIG. 4 Mannheimer at Fig. 4. An apparatus of and method for measuring arterial blood oxygen saturation at a particular tissue level of interest. Visible and near infrared radiation is emitted into a patient at the measurement site using two different wavelengths. Detection at two different detection sites permits rejection of oxygen saturation at undesired tissue levels. Mannheimer at Abstract. The present invention generally relates to instruments which operate on the principal of pulse oximetry and more particularly relates to instruments which non-invasively measure oxygen saturation of arterial blood in vivo. Mannheimer at 1:10-13.

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	Specifically, the present invention allows for pulsed oximetry measurement which isolates arterial saturation levels for particular ranges of tissue layers which rejects saturation levels of the tissue above or below the tissue of interest by utilizing multiple spaced detectors and/or emitters. According to one embodiment of the invention. a sensor for use with a pulse oximeter monitor comprises a patient interface housing for coupling to a patient; at least three sensor areas for emitting electromagnetic radiation which penetrates tissue of the patient and detects that electromagnetic radiation scattered by the tissue. a spacing between a first pair of electromagnetic emitter and electromagnetic detector being different than that of a spacing between a second pair of electromagnetic emitter and electromagnetic detector; and means for calculating an arterial oxygen saturation level of the patient in response to the detected electromagnetic radiation. Mannheimer at 2:1-18. FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 2:66-3:9. According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 3:10-22.

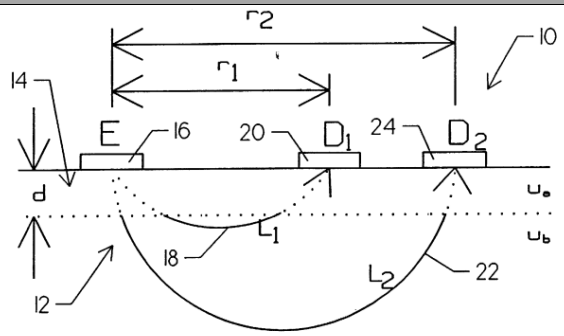
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	During the time that planar surface 28 is in position, emitter 16. detector 20. and detector 24 are in direct contact with the skin of the patient (see also F1G. 1). The spacing of emitter 16, detector 20. and detector 24 are as previously discussed. Mannheimer at 6:4-8. FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. Mannheimer at 6:17-32. Though the invention has been primarily described by reference to an apparatus having a single emitter area 16 which emits light of at least two differing and known wavelengths. and first and second separated detector areas 20.,24. it will be appreciated that the three sensor areas could also be achieved by having a single detector area and first and second separated emitter areas, each of which emit light at first and second differing and known wavelengths, as illustrated in FIG. 1B. Mannheimer at 7:31-39. Each different emitter/detector spacing pair could be used to calculate an oxygen saturation using different pulse oximetry signal processing methodologies as disclosed. and these multiple saturation values could be processed to image the tissue layers beneath the sensor areas or to reveal other desired information regarding these tissue layers. Mannheimer 7:51-58.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Mannheimer discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 3:10-22.

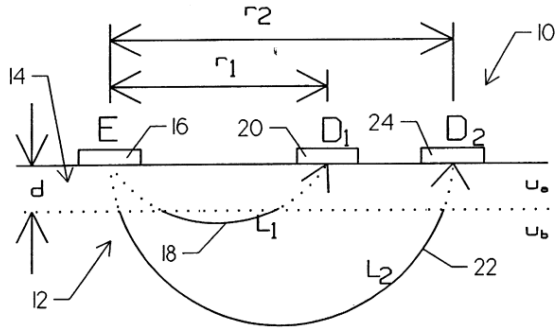
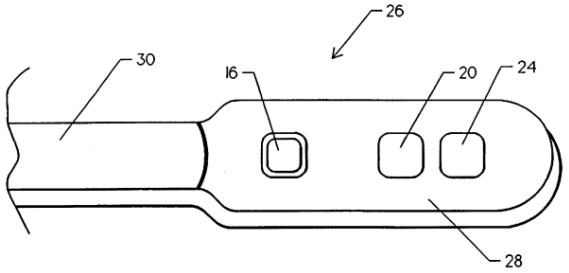
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’304 Patent	Mannheimer
	 FIG. 1 A Mannheimer at Fig. 1 The path length through skin layer 12 may be represented by l and the deeper path through the subdermal tissue by L1 and L2, depending on which detector is considered. Note that multiple emitters may transmit to a single detector as discussed below in relation to FIG. 1B. Following the formalism of Beer's Law, the signal detected at D 1 20 is given by: I.sub.1 =I.sub.o exp(-u.sub.a l).exp(-u.sub.b L.sub.1).exp(-u.sub.a l)(1) which describes the attenuation of the signal traveling twice through the skin layer 14 and once through the subdermal tissue 12 where: I1 =the detected light intensity at D1 Io =the emitted light intensity of emitter E ua =the characteristic absorption of layer 14 ub =the characteristic absorption of layer 12 l=the path length through layer 14 L1 =the path length through layer 12 The absorption coefficients can be rewritten as the product of the concentration of an absorbing constituent, c!, and its extinction coefficient β. In this case, c! is the concentration of total hemoglobin in the tissue. Allowing for different concentrations in the two layers, equation 1 becomes: $I_1=I_o\exp(-2\beta_a[c_a]l-\beta_b[c_b]L_1)$ To include the venous contribution, β[c] expands as follows:

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	$\beta[c]$ becomes $\beta_{art}[c]_{art} + \beta_{ven}[c]_{ven}$ Next is added the feature of pulse oximetry. Consider that the arterial blood concentration in both upper and lower layers vary with time following the cardiac cycle, and that the two layers may additionally have different pulse amplitudes. Assume the background venous blood concentration does not vary with the cardiac cycle. Taken at any convenient point in time (e.g. maxima or minima of the cardiac cycle), the logarithm of equation 2, considering equation 3, becomes: $\ln(I_1(t_1)) = I_o - 2(\beta_{a,art}[c_a(t_1)]_{art} + \beta_{a,ven}[c_a]_{ven}) l - (\beta_{b,art}[c_b(t_1)]_{art} + \beta_{b,ven}[c_b]_{ven}) L_1$ (4) Subtracting the signal observed at a second point in time, this expression simplifies: $\ln(I_1(t_1)) - \ln(I_1(t_2)) = -2(\beta_{a,art}\Delta[c_a]_{art}) l - (\beta_{b,art}\Delta[c_b]_{art}) L_1$ where Δ [c]art = c[(t1)]art – c[(t2)]art. Recalling that we assume the contribution of the skin layer has the same influence on both detectors, we can write a similar expression for the signals observed at detector D2: $\ln(I_2(t_1)) - \ln(I_2(t_2)) = -2(\beta_{a,art}\Delta[c_a]_{art}) l - (\beta_{b,art}\Delta[c_b]_{art}) L_2$ Subtracting equation 6 from equation 5, we find: $[\ln(I_1(t_1)) - \ln(I_1(t_2))] - [\ln(I_2(t_1)) - \ln(I_2(t_2))] = \beta_{b,art}\Delta[c_b]_{art}(L_2 - L_1)$ (7) Notice that the contribution of the skin layer has been eliminated. Finally, the measurements are repeated at a second wavelength. Taking the ratio of equation 7 evaluated at two wavelengths gives: $R = ([\ln(I_1(t_1)) - \ln(I_1(t_2))] - [\ln(I_2(t_1)) - \ln(I_2(t_2))])_{\lambda 1} / ([\ln(I_1(t_1)) - \ln(I_1(t_2))] - [\ln(I_2(t_1)) - \ln(I_2(t_2))])_{\lambda 2} = \beta_{b,art,\lambda 1}(L_2 - L_1)_{\lambda 1} / \beta_{b,art,\lambda 2}(L_2 - L_1)_{\lambda 2}$ (8) Equation 8 is equivalent to conventional pulse oximetry if the second detector is eliminated. In the conventional, nonscattering, model of oximetry, it is assumed that the average path lengths are equal at the two wavelengths--and they would simply drop out of equation 8. The model is improved, however, if the ratio of the average path lengths, or in this case the ratio of the difference lengths, is kept as an empirically determined correction factor: $R = \beta_{b,art,\lambda 1}/\beta_{b,art,\lambda 2} \cdot \Delta L_{\lambda 1}/\Delta L_{\lambda 2}$

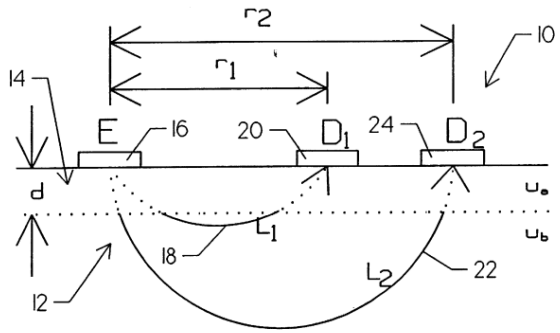
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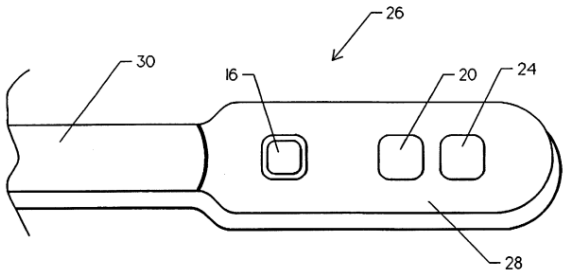
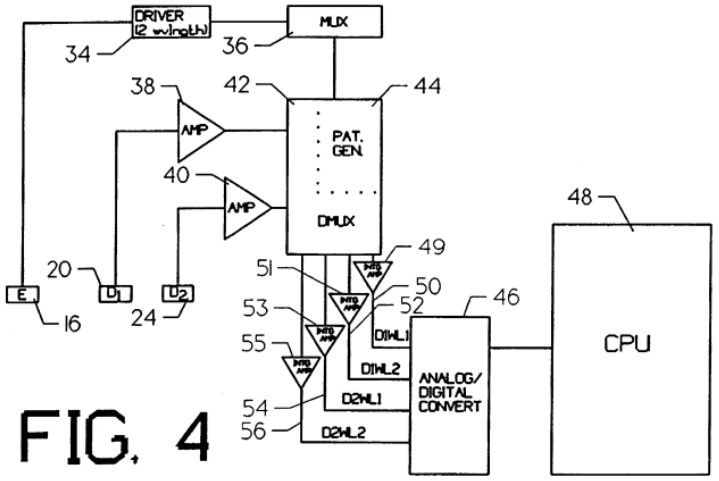
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	where ΔL=L2 -L1. In conventional pulse oximetry, the ratio of average path lengths is stable over a useful (but limited) saturation range. With the proper choice of wavelengths, this useful range can be engineered to cover specific meaningful clinical windows (e.g., 70-100% saturation or 40-60% saturation). The extinction coefficient can be rewritten in oxygen saturation terminology as: $\beta = S.\ \beta_{oxy} + (1-S).\beta_{red}$ Where S= O2 Hb!/(O2 Hb!+ Hb!) and where βoxy refers to oxygenated hemoglobin (O2 Hb) and βred refers to reduced hemoglobin (Hb) From this point on in the derivation, everything follows the conventional approach to pulse oximetry, applying equation 10 to 9, and solving for S(Sp,O2) in terms of the observation R: $S_pO_2 = [\beta_{red\lambda 2} - R.\ \beta_{red\lambda 1}]/[R.(\beta_{oxy\lambda 1} - \beta_{red\lambda 1}) - \beta_{oxy\lambda 2} + \beta_{red\lambda 2}]$ (11) In equation 11, the ratio of ΔL's has been absorbed into the appropriate β's as these will ultimately be determined empirically according to a preferred embodiment of the invention. This result differs from the conventional single detector pulse oximetry algorithm in that the skin layer signals are excluded from the measurement, regardless if the skin pulses or is non-pulsatile (e.g., vasoconstriction or exsanguination). Within the limitations of the assumptions made, as long as the upper skin layer does not create a shunt, and the deeper layer continues to pulse, this algorithm gives a result related only to the arterial blood saturation of the deeper tissue. Mannheimer at 3:36-5:9 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of

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	Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Mannheimer discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample.  FIG. 1 A Mannheimer at Fig. 1A  FIG. 2 Mannheimer at Fig. 2.

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	FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 2:66-3:9 According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Detector 20 is spaced a distance of r1 from emitter 16 and detector 24 is spaced at a distance of r2. As can be seen in the drawing, both path 18 and path 22 traverse skin layer 14 twice. Furthermore, because paths 18 and 22 traverse skin layer 14 using approximately the same angle, the primary difference between paths 22 and 18 is the difference between length L2 and length L1 traversing subdermal layer 12, which is the tissue layer of interest. Therefore, it can be assumed that the difference in absorption between path L2 and path L1 is directly attributable to subdermal layer 12, the tissue layer of interest, corresponding to the different spacings r2 and r1. Mannheimer at 3:10-35 FIG. 2 is a perspective view of the preferred mode of patient interface device 26 employing the present invention. Planar surface 28 is placed into contact with the skin of the patient during monitoring and measurement. If desirable, this position may be maintained via adhesive or other mechanical means known in the art. Further, if desirable, surface 28 may have a curvature, and may be either flexible or rigid. During the time that planar surface 28 is in position, emitter 16, detector 20, and detector 24 are in

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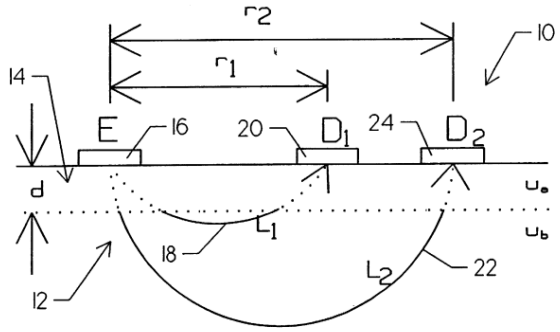
’304 Patent	Mannheimer
	direct contact with the skin of the patient (see also FIG. 1). The spacing of emitter 16, detector 20, and detector 24 are as previously discussed. Mannheimer at 5:63-6:8. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d]. the wearable measurement device further comprising a receiver configured to:	Mannheimer discloses or renders obvious the wearable measurement device further comprising a receiver.  FIG. 1 A Mannheimer at Fig. 1A

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	 FIG. 2 Mannheimer at Fig. 2.  FIG. 4 Mannheimer at Fig. 4. According to one embodiment of the invention. a sensor for use with a pulse oximeter monitor comprises a patient interface housing for coupling to a patient; at least three sensor areas for emitting electromagnetic radiation which penetrates tissue of the patient and detects that electromagnetic radiation scattered by the tissue. a spacing between a first pair of electromagnetic emitter and electromagnetic

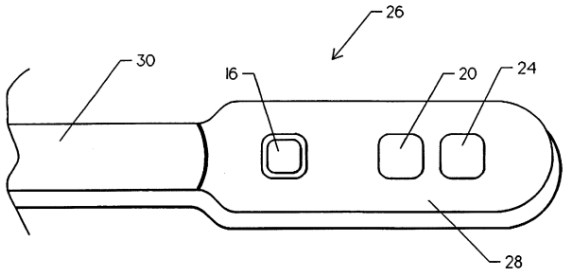
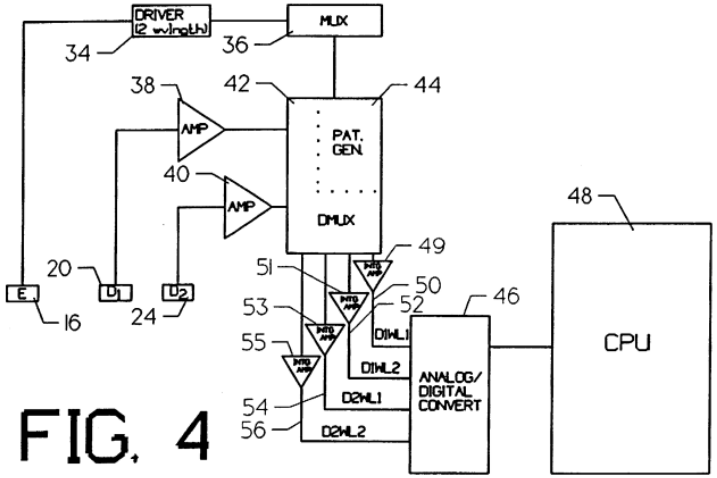
’304 Patent	Mannheimer
	detector being different than that of a spacing between a second pair of electromagnetic emitter and electromagnetic detector; and means for calculating an arterial oxygen saturation level of the patient in response to the detected electromagnetic radiation. According to two preferred embodiments. the sensor areas comprise first and second separated and spaced apart emitter areas each capable of generating light of at least two distinct wavelengths. and a detector. the first emitter area and the detector corresponding to a first pair of emitter and detector, the second emitter area and the detector corresponding to the second pair of emitter and detector; or the sensor areas comprise first and second detector areas each capable of detecting light of at least two separate wavelength values. and an emitter area capable of generating said light having the at least two separated wavelength values. Mannheimer at 2:7-30. According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 3:10-22. The separation of the first emitter/detector pair 16,20 (i.e. r1) and the second emitter/detector pair 16,24 (i.e. r2) should be larger than several times the skin thickness (i.e. r1,r2 much greater than d) so that the four occurrences of are all approximately equal, or at least have equivalent counterparts influencing the two detectors. The detector separation from the emitter should also be large enough to probe "deep" enough, the probed depth somewhat less than the separation. The two detectors should not be too far separated from one another, however, or else the assumption of equivalent skin thickness may be violated. If the detectors are too close to each other, ΔL becomes 0 and the measurement becomes unstable (see equation 9).

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	Mannheimer at 5:1-9 F1G. 1B is a schematic diagram. similar to F1G. 1A, showing the present invention employing multiple emitters 16 and 17 and a single detector 24. Those of skill in the art will appreciate that the operation is similar to that described above. F1G. 2 is a perspective view of the preferred mode of patient interface device 26 employing the present invention. Planar surface 28 is placed into contact with the skin of the patient during monitoring and measurement. If desirable, this position may be maintained via adhesive or other mechanical means known in the art. Further. if desirable, surface 28 may have a curvature, and may be either flexible or rigid. During the time that planar surface 28 is in position, emitter 16. detector 20. and detector 24 are in direct contact with the skin of the patient (see also F1G. 1). The spacing of emitter 16, detector 20. and detector 24 are as previously discussed. Wiring, not shown in this view. electrically couples emitter 16. detector 20. and detector 24 to the circuitry which performs the monitoring functions. Mannheimer at 5:63-6:11. FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. Mannheimer at 6:17-32.

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	The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly. the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 7:8-17. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample,	Mannheimer discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample.  FIG. 1 A

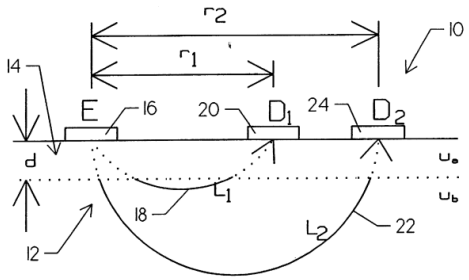
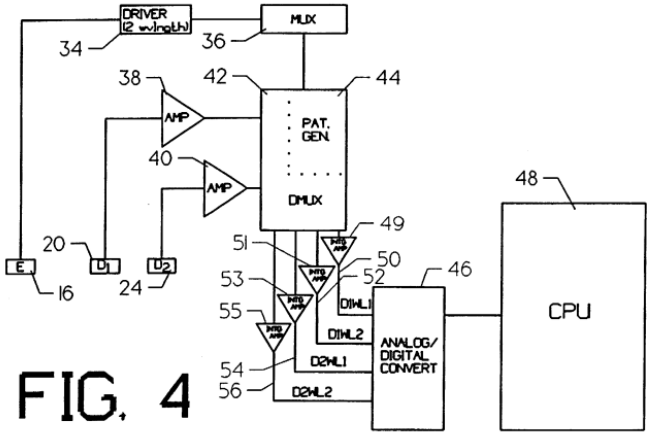
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	Mannheimer at Fig. 1A  FIG. 2 Mannheimer at Fig. 2.  FIG. 4 Mannheimer at Fig. 4. According to one embodiment of the invention. a sensor for use with a pulse oximeter monitor comprises a patient interface housing for coupling to a patient; at least three sensor areas for emitting

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	electromagnetic radiation which penetrates tissue of the patient and detects that electromagnetic radiation scattered by the tissue. a spacing between a first pair of electromagnetic emitter and electromagnetic detector being different than that of a spacing between a second pair of electromagnetic emitter and electromagnetic detector; and means for calculating an arterial oxygen saturation level of the patient in response to the detected electromagnetic radiation. According to two preferred embodiments. the sensor areas comprise first and second separated and spaced apart emitter areas each capable of generating light of at least two distinct wavelengths. and a detector. the first emitter area and the detector corresponding to a first pair of emitter and detector, the second emitter area and the detector corresponding to the second pair of emitter and detector; or the sensor areas comprise first and second detector areas each capable of detecting light of at least two separate wavelength values. and an emitter area capable of generating said light having the at least two separated wavelength values. Mannheimer at 2:7-30. According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 3:10-22. FIG. 2 is a perspective view of the preferred mode of patient interface device 26 employing the present invention. Planar surface 28 is placed into contact with the skin of the patient during monitoring and measurement. If desirable, this position may be maintained via adhesive or other mechanical means known in the art. Further, if desirable, surface 28 may have a curvature, and may be either flexible or rigid. During the time that planar surface 28 is in position, emitter 16, detector 20, and detector 24 are in

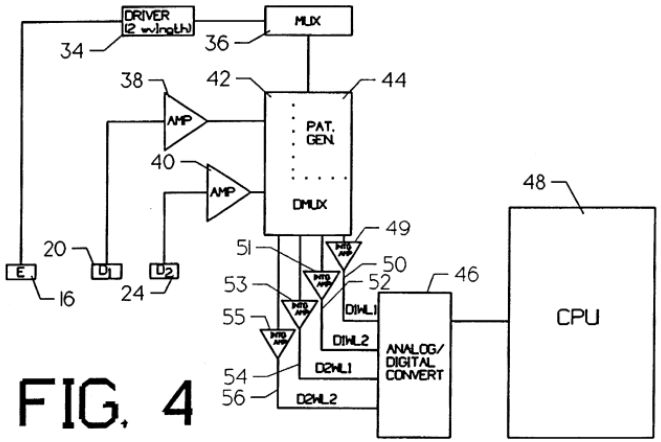
’304 Patent	Mannheimer
	direct contact with the skin of the patient (see also FIG. 1). The spacing of emitter 16, detector 20, and detector 24 are as previously discussed. Mannheimer at 5:63-6:8. FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. Mannheimer at 6:17-32. The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly. the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 7:8-17. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of

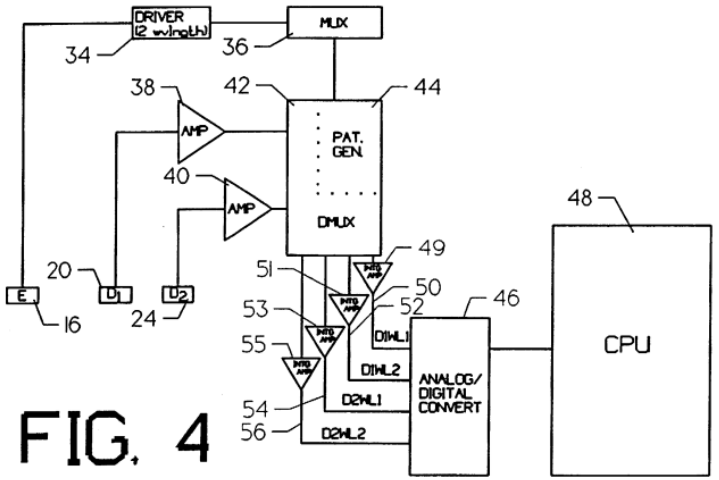
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’304 Patent	Mannheimer
	Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Mannheimer discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample.  FIG. 1 A Mannheimer at Fig. 1A  FIG. 4 Mannheimer at Fig. 4.

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	According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 3:10-22. FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. Mannheimer at 6:17-32. The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly. the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 7:8-17.

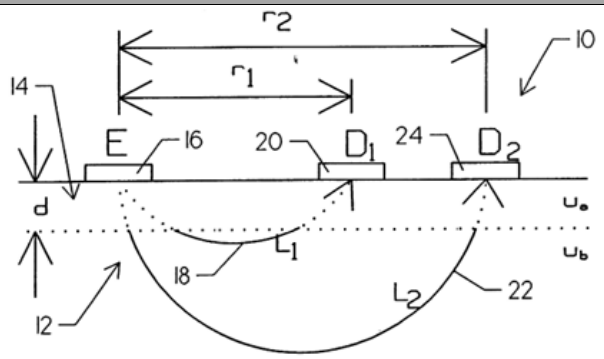
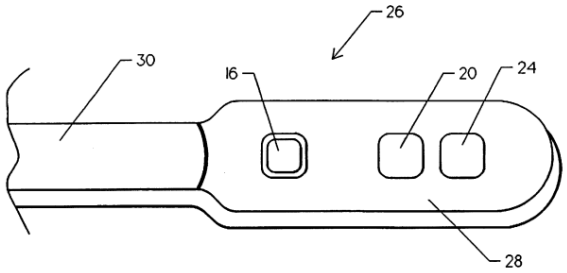
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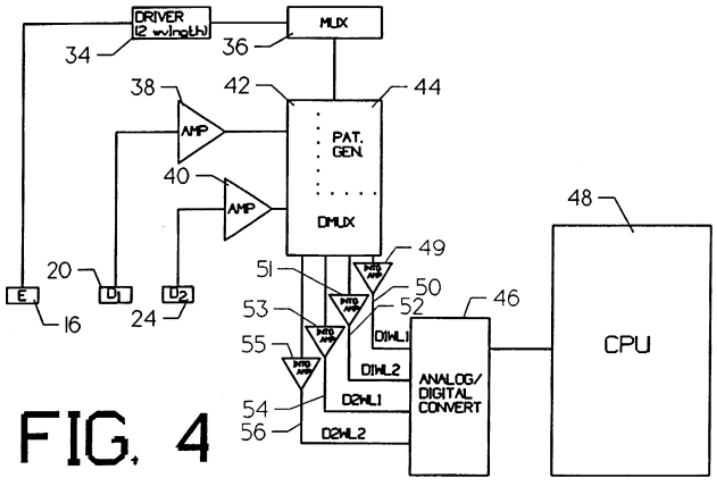
’304 Patent	Mannheimer
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	Mannheimer discloses or renders obvious the receiver configured to synchronize to the light source.  FIG. 4 Mannheimer at Fig. 4. FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively,

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	lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. Mannheimer at 6:17-32. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the captured light into a first signal,	Mannheimer discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal.  FIG. 4 Mannheimer at Fig. 4.

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	FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. Mannheimer at 6:17-32. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Mannheimer discloses or renders obvious the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample.

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	 FIG. 1 A Mannheimer at Fig. 1A.  FIG. 2 Mannheimer at Fig. 2.

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	 FIG. 4 Mannheimer at Fig. 4. FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 2:66-3:9. FIG. 2 is a perspective view of the preferred mode of patient interface device 26 employing the present invention. Planar surface 28 is placed into contact with the skin of the patient during monitoring and measurement. If desirable, this position may be maintained via adhesive or other mechanical means known in the art. Further, if desirable, surface 28 may have a curvature, and may be either flexible or rigid. During the time that planar surface 28 is in position, emitter 16, detector 20, and detector 24 are in direct contact with the skin of the patient (see also FIG. 1). The spacing of emitter 16, detector 20, and detector 24 are as previously discussed.

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	Mannheimer at 5:63-6:8. FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. Mannheimer at 6:17-32. According to a preferred embodiment. CPU 48 identifies and qualifies arterial pulses from the signals D1, λ1; D1, λ2; D2, λ1, D2, λ2 using any of the signal processing techniques described in U.S. Pat. Nos. 4,869,254; 5,078,136; 4,911,167; 4,934,372; 4,802,486; and 4,928,692, the disclosures of which are all incorporated herein by reference. Mannheimer at 6:44-49. The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly. the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 7:8-17. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Mannheimer discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. The path length through skin layer 12 may be represented by l and the deeper path through the subdermal tissue by L1 and L2, depending on which detector is considered. Note that multiple emitters may transmit to a single detector as discussed below in relation to FIG. 1B. Following the formalism of Beer's Law, the signal detected at D 1 20 is given by: I.sub.1 =I.sub.o exp(-u.sub.a l).exp(-u.sub.b L.sub.1).exp(-u.sub.a l)(1) which describes the attenuation of the signal traveling twice through the skin layer 14 and once through the subdermal tissue 12 where: I1 =the detected light intensity at D1 Io =the emitted light intensity of emitter E ua =the characteristic absorption of layer 14 ub =the characteristic absorption of layer 12 l=the path length through layer 14 L1 =the path length through layer 12 The absorption coefficients can be rewritten as the product of the concentration of an absorbing constituent, c!, and its extinction coefficient β. In this case, c! is the concentration of total hemoglobin in the tissue. Allowing for different concentrations in the two layers, equation 1 becomes: $I_1=I_o\exp(-2\beta_a[c_a]l-\beta_b[c_b]L_1)$ To include the venous contribution, β[c] expands as follows: $\beta[c]$ becomes $\beta_{art}[c]_{art}+\beta_{ven}[c]_{ven}$ Next is added the feature of pulse oximetry. Consider that the arterial blood concentration in both upper and lower layers vary with time following the cardiac cycle, and that the two layers may additionally have different pulse amplitudes. Assume the background venous blood concentration does not vary with

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	the cardiac cycle. Taken at any convenient point in time (e.g. maxima or minima of the cardiac cycle), the logarithm of equation 2, considering equation 3, becomes: $\ln(I_1(t_1))=I_o-2(\beta_{a,art}[c_a(t_1)]_{art}+\beta_{a,ven}[c_a]_{ven})l-(\beta_{b,art}[c_b(t_1)]_{art}+\beta_{b,ven}[c_b]_{ven})L_1$ (4) Subtracting the signal observed at a second point in time, this expression simplifies: $\ln(I_1(t_1))-\ln(I_1(t_2))=-2(\beta_{a,art}\Delta[c_a]_{art})l-(\beta_{b,art}\Delta[c_b]_{art})L_1$ where Δ [c]art = c[(t1)]art – c[(t2)]art. Recalling that we assume the contribution of the skin layer has the same influence on both detectors, we can write a similar expression for the signals observed at detector D2: $\ln(I_2(t_1))-\ln(I_2(t_2))=-2(\beta_{a,art}\Delta[c_a]_{art})l-(\beta_{b,art}\Delta[c_b]_{art})L_2$ Subtracting equation 6 from equation 5, we find: $[\ln(I_1(t_1))-\ln(I_1(t_2))]-[\ln(I_2(t_1))-\ln(I_2(t_2))]=\beta_{b,art}\Delta[c_b]_{art}(L_2-L_1)$ (7) Notice that the contribution of the skin layer has been eliminated. Finally, the measurements are repeated at a second wavelength. Taking the ratio of equation 7 evaluated at two wavelengths gives: $R=([\ln(I_1(t_1))-\ln(I_1(t_2))]-[\ln(I_2(t_1))-\ln(I_2(t_2))])_{\lambda1}/([\ln(I_1(t_1))-\ln(I_1(t_2))]-[\ln(I_2(t_1))-\ln(I_2(t_2))])_{\lambda2}=\beta_{b,art,\lambda1}(L_2-L_1)_{\lambda1}/\beta_{b,art,\lambda2}(L_2-L_1)_{\lambda2}$ (8) Equation 8 is equivalent to conventional pulse oximetry if the second detector is eliminated. In the conventional, nonscattering, model of oximetry, it is assumed that the average path lengths are equal at the two wavelengths--and they would simply drop out of equation 8. The model is improved, however, if the ratio of the average path lengths, or in this case the ratio of the difference lengths, is kept as an empirically determined correction factor: $R=\beta_{b,art,\lambda1}/\beta_{b,art,\lambda2}\cdot\Delta L_{\lambda1}/\Delta L_{\lambda2}$ where $\Delta L=L2-L1$. In conventional pulse oximetry, the ratio of average path lengths is stable over a useful (but limited) saturation range. With the proper choice of wavelengths, this useful range can be engineered to cover specific meaningful clinical windows (e.g., 70-100% saturation or 40-60% saturation). The extinction coefficient can be rewritten in oxygen saturation terminology as:

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	$\beta=S.\ \beta_{oxy}+(1-S).\beta_{red}$ Where S= O2 Hb!/(O2 Hb!+ Hb!) and where βoxy refers to oxygenated hemoglobin (O2 Hb) and βred refers to reduced hemoglobin (Hb) From this point on in the derivation, everything follows the conventional approach to pulse oximetry, applying equation 10 to 9, and solving for S(Sp,O2) in terms of the observation R: $S_pO_2=[\beta_{red\lambda 2}-R.\ \beta_{red\lambda 1}]/[R.(\beta_{oxy\lambda 1}-\beta_{red\lambda 1})-\beta_{oxy\lambda 2}+\beta_{red\lambda 2}]$ (11) In equation 11, the ratio of ΔL's has been absorbed into the appropriate β's as these will ultimately be determined empirically according to a preferred embodiment of the invention. This result differs from the conventional single detector pulse oximetry algorithm in that the skin layer signals are excluded from the measurement, regardless if the skin pulses or is non-pulsatile (e.g., vasoconstriction or exsanguination). Within the limitations of the assumptions made, as long as the upper skin layer does not create a shunt, and the deeper layer continues to pulse, this algorithm gives a result related only to the arterial blood saturation of the deeper tissue. Mannheimer at 3:36-5:9 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a	Mannheimer discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the

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microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. This result differs from the conventional single detector pulse oximetry algorithm in that the skin layer signals are excluded from the measurement, regardless if the skin pulses or is non-pulsatile (e.g., vasoconstriction or exsanguination). Within the limitations of the assumptions made, as long as the upper skin layer does not create a shunt, and the deeper layer continues to pulse, this algorithm gives a result related only to the arterial blood saturation of the deeper tissue. Mannheimer at 5:1-9 The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired. As previously described, if deep tissue properties are desired, CPU 48 calculates R using equation 8 and $S_p O_2$ using equation 11 with constants $\beta_{red},\lambda 2,\beta_{red},\lambda 1,\beta_{oxy},\lambda 1$, and $\beta_{oxy},\lambda 2$ being stored in CPU memory, having been previously determined empirically. If shallow tissue properties are desired, CPU 48 calculates R using equation 15 and $S_p O_2$ using equation 11. According to a preferred embodiment, CPU 48 identifies and qualifies arterial pulses from the signals D_1, λ_1 ; D_1, λ_2 ; D_2, λ_1, D_2, λ_2 using any of the signal processing techniques described in U.S. Pat. Nos. 4,869,254; 5,078,136; 4,911,167; 4,934,372; 4,802,486; and 4,928,692, the disclosures of which are all incorporated herein by reference. Mannheimer at 6:31-49. The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly. the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level.

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	Mannheimer at 7:8-17. FIG. 7 is a graph illustrating data obtained from computer models of arterial oxygen saturation calculated using traditional techniques for a single detector, and using first and second detectors as described in FIG. 1. As can be seen, the ratios of the deep track very closely with the ratios from the conventional system. Mannheimer at 7:25-30. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Mannheimer discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. This result differs from the conventional single detector pulse oximetry algorithm in that the skin layer signals are excluded from the measurement, regardless if the skin pulses or is non-pulsatile (e.g., vasoconstriction or exsanguination). Within the limitations of the assumptions made, as long as the upper skin layer does not create a shunt, and the deeper layer continues to pulse, this algorithm gives a result related only to the arterial blood saturation of the deeper tissue. Mannheimer at 5:1-9

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	The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired. As previously described, if deep tissue properties are desired, CPU 48 calculates R using equation 8 and $S_p O_2$ using equation 11 with constants $\beta_{red},\lambda 2,\beta_{red},\lambda 1,\beta_{oxy},\lambda 1$, and $\beta_{oxy},\lambda 2$ being stored in CPU memory, having been previously determined empirically. If shallow tissue properties are desired, CPU 48 calculates R using equation 15 and $S_p O_2$ using equation 11. According to a preferred embodiment, CPU 48 identifies and qualifies arterial pulses from the signals D_1, λ_1 ; D_1, λ_2 ; D_2, λ_1, D_2, λ_2 using any of the signal processing techniques described in U.S. Pat. Nos. 4,869,254; 5,078,136; 4,911,167; 4,934,372; 4,802,486; and 4,928,692, the disclosures of which are all incorporated herein by reference. Mannheimer at 6:31-49. The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly. the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 7:8-17. FIG. 7 is a graph illustrating data obtained from computer models of arterial oxygen saturation calculated using traditional techniques for a single detector, and using first and second detectors as described in FIG. 1. As can be seen, the ratios of the deep track very closely with the ratios from the conventional system. Mannheimer at 7:25-30.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mannheimer discloses or renders obvious the measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. This result differs from the conventional single detector pulse oximetry algorithm in that the skin layer signals are excluded from the measurement, regardless if the skin pulses or is non-pulsatile (e.g., vasoconstriction or exsanguination). Within the limitations of the assumptions made, as long as the upper skin layer does not create a shunt, and the deeper layer continues to pulse, this algorithm gives a result related only to the arterial blood saturation of the deeper tissue. Mannheimer at 5:1-9 The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired. As previously described, if deep tissue properties are desired, CPU 48 calculates R using equation 8 and $S_p O_2$ using equation 11 with constants $\beta_{red},\lambda 2,\beta_{red},\lambda 1,\beta_{oxy},\lambda 1$, and $\beta_{oxy},\lambda 2$ being stored in CPU memory, having been previously determined empirically. If shallow tissue properties are desired, CPU 48 calculates R using equation 15 and $S_p O_2$ using equation 11.

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	According to a preferred embodiment, CPU 48 identifies and qualifies arterial pulses from the signals D_1, λ_1 ; D_1, λ_2 ; D_2, λ_1, D_2, λ_2 using any of the signal processing techniques described in U.S. Pat. Nos. 4,869,254; 5,078,136; 4,911,167; 4,934,372; 4,802,486; and 4,928,692, the disclosures of which are all incorporated herein by reference. Mannheimer at 6:31-49. The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly. the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 7:8-17. FIG. 7 is a graph illustrating data obtained from computer models of arterial oxygen saturation calculated using traditional techniques for a single detector, and using first and second detectors as described in FIG. 1. As can be seen, the ratios of the deep track very closely with the ratios from the conventional system. Mannheimer at 7:25-30. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Mannheimer discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. This result differs from the conventional single detector pulse oximetry algorithm in that the skin layer signals are excluded from the measurement, regardless if the skin pulses or is non-pulsatile (e.g., vasoconstriction or exsanguination). Within the limitations of the assumptions made, as long as the upper skin layer does not create a shunt, and the deeper layer continues to pulse, this algorithm gives a result related only to the arterial blood saturation of the deeper tissue. Mannheimer at 5:1-9 The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired. As previously described, if deep tissue properties are desired, CPU 48 calculates R using equation 8 and $S_p O_2$ using equation 11 with constants β_{red},$\lambda 2$,β_{red},$\lambda 1$,β_{oxy},$\lambda 1$, and β_{oxy},$\lambda 2$ being stored in CPU memory, having been previously determined empirically. If shallow tissue properties are desired, CPU 48 calculates R using equation 15 and $S_p O_2$ using equation 11. According to a preferred embodiment, CPU 48 identifies and qualifies arterial pulses from the signals D_1, λ_1 ; D_1, λ_2 ; D_2, λ_1, D_2, λ_2 using any of the signal processing techniques described in U.S. Pat. Nos. 4,869,254; 5,078,136; 4,911,167; 4,934,372; 4,802,486; and 4,928,692, the disclosures of which are all incorporated herein by reference. Mannheimer at 6:31-49. The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly. the signal from the second

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	wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 7:8-17. FIG. 7 is a graph illustrating data obtained from computer models of arterial oxygen saturation calculated using traditional techniques for a single detector, and using first and second detectors as described in FIG. 1. As can be seen, the ratios of the deep track very closely with the ratios from the conventional system. Mannheimer at 7:25-30. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Mannheimer discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. This result differs from the conventional single detector pulse oximetry algorithm in that the skin layer signals are excluded from the measurement, regardless if the skin pulses or is non-pulsatile (e.g., vasoconstriction or exsanguination). Within the limitations of the assumptions made, as long as the upper skin layer does not create a shunt, and the deeper layer continues to pulse, this algorithm gives a result related only to the arterial blood saturation of the deeper tissue.

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	Mannheimer at 5:1-9 The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired. As previously described, if deep tissue properties are desired, CPU 48 calculates R using equation 8 and $S_p O_2$ using equation 11 with constants β_{red},$\lambda 2$,β_{red},$\lambda 1$,β_{oxy},$\lambda 1$, and β_{oxy},$\lambda 2$ being stored in CPU memory, having been previously determined empirically. If shallow tissue properties are desired, CPU 48 calculates R using equation 15 and $S_p O_2$ using equation 11. According to a preferred embodiment, CPU 48 identifies and qualifies arterial pulses from the signals D_1, λ_1 ; D_1, λ_2 ; D_2, λ_1, D_2, λ_2 using any of the signal processing techniques described in U.S. Pat. Nos. 4,869,254; 5,078,136; 4,911,167; 4,934,372; 4,802,486; and 4,928,692, the disclosures of which are all incorporated herein by reference. Mannheimer at 6:31-49. The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly. the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 7:8-17. FIG. 7 is a graph illustrating data obtained from computer models of arterial oxygen saturation calculated using traditional techniques for a single detector, and using first and second detectors as described in FIG. 1. As can be seen, the ratios of the deep track very closely with the ratios from the conventional system.

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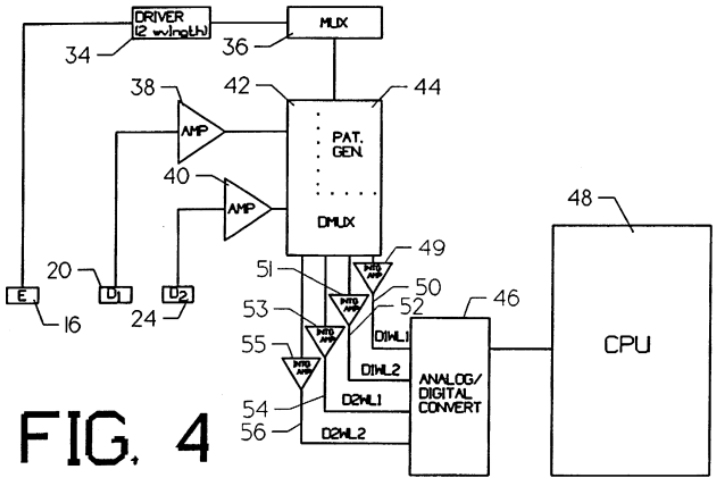
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	Mannheimer at 7:25-30. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Mannheimer discloses or renders obvious the measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. The path length through skin layer 12 may be represented by l and the deeper path through the subdermal tissue by L1 and L2, depending on which detector is considered. Note that multiple emitters may transmit to a single detector as discussed below in relation to FIG. 1B. Following the formalism of Beer's Law, the signal detected at D 1 20 is given by: I.sub.1 =I.sub.o exp(-u.sub.a l).exp(-u.sub.b L.sub.1).exp(-u.sub.a l)(1) which describes the attenuation of the signal traveling twice through the skin layer 14 and once through the subdermal tissue 12 where: I1 =the detected light intensity at D1 Io =the emitted light intensity of emitter E ua =the characteristic absorption of layer 14 ub =the characteristic absorption of layer 12 l=the path length through layer 14 L1 =the path length through layer 12 The absorption coefficients can be rewritten as the product of the concentration of an absorbing constituent, c!, and its extinction coefficient β. In this case, c! is the concentration of total hemoglobin in the tissue. Allowing for different concentrations in the two layers, equation 1 becomes:

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	$I_1=I_o\exp(-2\beta_a[c_a]l-\beta_b[c_b]L_1)$ To include the venous contribution, β[c] expands as follows: β[c] becomes $\beta_{art}[c]_{art}+\beta_{ven}[c]_{ven}$ Next is added the feature of pulse oximetry. Consider that the arterial blood concentration in both upper and lower layers vary with time following the cardiac cycle, and that the two layers may additionally have different pulse amplitudes. Assume the background venous blood concentration does not vary with the cardiac cycle. Taken at any convenient point in time (e.g. maxima or minima of the cardiac cycle), the logarithm of equation 2, considering equation 3, becomes: $\ln(I_1(t_1))=I_o-2(\beta_{a,art}[c_a(t_1)]_{art}+\beta_{a,ven}[c_a]_{ven})l-(\beta_{b,art}[c_b(t_1)]_{art}+\beta_{b,ven}[c_b]_{ven})L_1$ (4) Subtracting the signal observed at a second point in time, this expression simplifies: $\ln(I_1(t_1))-\ln(I_1(t_2))=-2(\beta_{a,art}\Delta[c_a]_{art})l-(\beta_{b,art}\Delta[c_b]_{art})L_1$ where Δ [c]art = c[(t1)]art – c[(t2)]art. Recalling that we assume the contribution of the skin layer has the same influence on both detectors, we can write a similar expression for the signals observed at detector D2: $\ln(I_2(t_1))-\ln(I_2(t_2))=-2(\beta_{a,art}\Delta[c_a]_{art})l-(\beta_{b,art}\Delta[c_b]_{art})L_2$ Subtracting equation 6 from equation 5, we find: $[\ln(I_1(t_1))-\ln(I_1(t_2))]-[\ln(I_2(t_1))-\ln(I_2(t_2))]=\beta_{b,art}\Delta[c_b]_{art}(L_2-L_1)$ (7) Notice that the contribution of the skin layer has been eliminated. Finally, the measurements are repeated at a second wavelength. Taking the ratio of equation 7 evaluated at two wavelengths gives: $R=([\ln(I_1(t_1))-\ln(I_1(t_2))]-[\ln(I_2(t_1))-\ln(I_2(t_2))])_{\lambda 1}/([\ln(I_1(t_1))-\ln(I_1(t_2))]-[\ln(I_2(t_1))-\ln(I_2(t_2))])_{\lambda 2}=\beta_{b,art,\lambda 1}(L_2-L_1)_{\lambda 1}/\beta_{b,art,\lambda 2}(L_2-L_1)_{\lambda 2}$ (8) Equation 8 is equivalent to conventional pulse oximetry if the second detector is eliminated. In the conventional, nonscattering, model of oximetry, it is assumed that the average path lengths are equal at the two wavelengths--and they would simply drop out of equation 8. The model is improved, however,

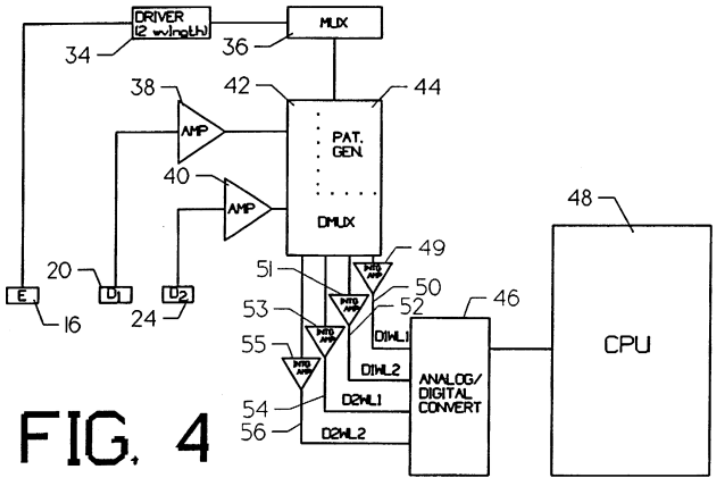
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	if the ratio of the average path lengths, or in this case the ratio of the difference lengths, is kept as an empirically determined correction factor: $R=\beta_{b,art,\lambda1}/\beta_{b,art,\lambda2}\cdot\Delta L_{\lambda1}/\Delta L_{\lambda2}$ where ΔL=L2 -L1. In conventional pulse oximetry, the ratio of average path lengths is stable over a useful (but limited) saturation range. With the proper choice of wavelengths, this useful range can be engineered to cover specific meaningful clinical windows (e.g., 70-100% saturation or 40-60% saturation). The extinction coefficient can be rewritten in oxygen saturation terminology as: $\beta=S.\ \beta_{oxy}+(1-S).\beta_{red}$ Where S= O2 Hb!/(O2 Hb!+ Hb!) and where βoxy refers to oxygenated hemoglobin (O2 Hb) and βred refers to reduced hemoglobin (Hb) From this point on in the derivation, everything follows the conventional approach to pulse oximetry, applying equation 10 to 9, and solving for S(Sp,O2) in terms of the observation R: $S_pO_2=[\beta_{red\lambda2}-R.\ \beta_{red\lambda1}]/[R.(\beta_{oxy\lambda1}-\beta_{red\lambda1})-\beta_{oxy\lambda2}+\beta_{red\lambda2}]$ (11) In equation 11, the ratio of ΔL's has been absorbed into the appropriate β's as these will ultimately be determined empirically according to a preferred embodiment of the invention. This result differs from the conventional single detector pulse oximetry algorithm in that the skin layer signals are excluded from the measurement, regardless if the skin pulses or is non-pulsatile (e.g., vasoconstriction or exsanguination). Within the limitations of the assumptions made, as long as the upper skin layer does not create a shunt, and the deeper layer continues to pulse, this algorithm gives a result related only to the arterial blood saturation of the deeper tissue. Mannheimer at 3:36-5:9 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Mannheimer discloses or renders obvious the measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above.  FIG. 4 Mannheimer at Fig. 4. According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is

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	shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 3:10-22. FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. Mannheimer at 6:17-32. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a	Mannheimer discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.

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plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	*See* claim 11 above.  FIG. 4 Mannheimer at Fig. 4. According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 3:10-22. FIG. 2 is a perspective view of the preferred mode of patient interface device 26 employing the present invention. Planar surface 28 is placed into contact with the skin of the patient during monitoring and measurement. If desirable, this position may be maintained via adhesive or other mechanical means

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	known in the art. Further, if desirable, surface 28 may have a curvature, and may be either flexible or rigid. During the time that planar surface 28 is in position, emitter 16, detector 20, and detector 24 are in direct contact with the skin of the patient (see also FIG. 1). The spacing of emitter 16, detector 20, and detector 24 are as previously discussed. Wiring, not shown in this view, electrically couples emitter 16, detector 20, and detector 24 to the circuitry which performs the monitoring functions. FIG. 3 is a partially sectioned view showing patient interface device 26 in operational position. Cable 32 conducts the electrical signals to and from the monitoring circuitry as described below. All other elements are as previously described. Mannheimer at 5:63-6:16. FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. Mannheimer at 6:17-32. Though the invention has been primarily described by reference to an apparatus having a single emitter area 16 which emits light of at least two differing and known wavelengths, and first and second separated detector areas 20, 24, it will be appreciated that the three sensor areas could also be achieved by having a single detector area and first and second separated emitter areas, each of which emit light at first and second differing and known wavelengths, as illustrated in FIG. 1B. According to a preferred

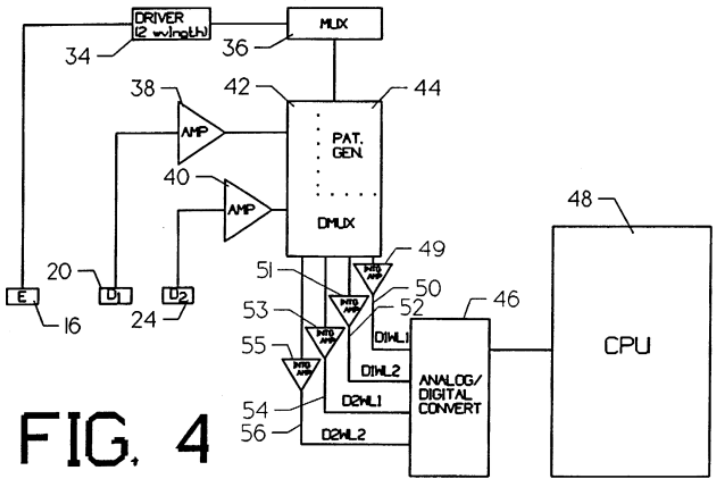
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	embodiment, the signals are transmitted by the emitters and detected by the detectors using standard time signal multiplex techniques, though other signal multiplex techniques could alternately be used if desired (e.g. frequency multiplex). In addition, increased resolution between differing tissue layers is achievable if increased number of sensor areas is utilized. For example, a half dozen or more detector areas could be utilized in combination with a single emitter area, or half dozen or more dual wavelength emitter areas could be utilized in combination with a single detector area. In addition, the sensor areas could be aligned in a linear array, either straight or curved, or could be disposed in a two-dimensional array. Each different emitter/detector spacing pair could be used to calculate an oxygen saturation using different pulse oximetry signal processing methodologies as disclosed, and these multiple saturation values could be processed to image the tissue layers beneath the sensor areas or to reveal other desired information regarding these tissue layers. Mannheimer at 7:31-58. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Mannheimer discloses or renders obvious the measurement system of claim 15, wherein the first arc and the second arc are concentric. *See* claim 15 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mannheimer discloses or renders obvious a wearable device for use with a smart phone or tablet, the wearable device. *See* 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	Mannheimer discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Mannheimer discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths.  FIG. 4 Mannheimer at Fig. 4. According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 3:10-22.

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	FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. Mannheimer at 6:17-32. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Mannheimer discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of

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	Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;	Mannheimer discloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue; *See* 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Mannheimer discloses or renders obvious the measurement device configured to synchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Mannheimer discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Mannheimer discloses or renders obvious increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[a], 11[b], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement	Mannheimer discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 11[a], 11[f], 19[a].

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on blood contained within the tissue;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Mannheimer discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link.	Mannheimer discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal and transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Mannheimer discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claims 19, 13 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Mannheimer discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claims 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of

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	Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Mannheimer discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claims 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant's Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D10

U.S. Pat. No. 10,874,304 in view of U.S. Patent Publication No. 20030208113 to James R Mault et al. ("Mault")

As described in detail below, Mault (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D9 and D11-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Mault. The cited portions of Mault are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Mault. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Mault "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Mault does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Mault (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Mault anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 11	
11[pre] A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mault discloses or renders obvious a measurement system. Embodiments of the present invention provide methods of blood glucose management systems that allow a person to view projected future levels of blood glucose, so as to assist the person to keep blood glucose levels within a predetermined range, such as a medically advisable healthy range. Systems are provided by which a person can view future projections of blood glucose levels in based on actions or planned actions, receive advance warnings of possible excursions of blood glucose from the predetermined range, and receive advice on diet, exercise, behavior modification, or medical treatments that can help the person prevent the blood glucose level excursions into unhealthy ranges. Mault at [0013] The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] A system for controlling a blood glucose level of a person comprises: a blood glucose sensor, providing data correlated with the blood glucose level of the person; a computing device, having a display; a software program, running on the computing device, adapted to receive data from the blood glucose sensor, further adapted to receive food consumption data from the person, and further having an algorithm so as to display a blood glucose projection on the display. Mault at [0037]

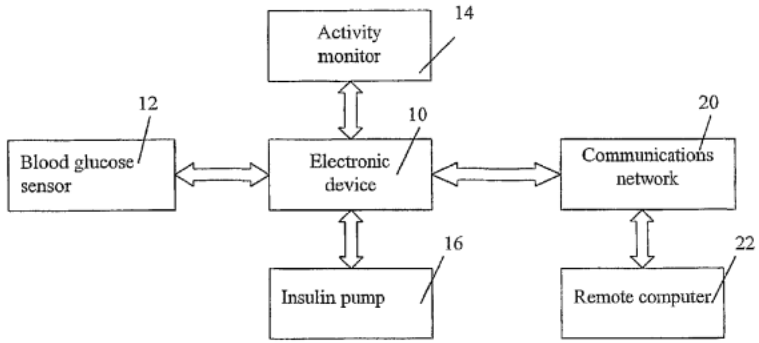
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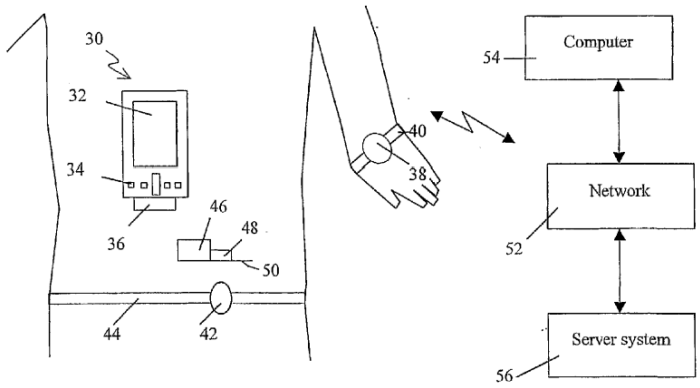
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	A system for assisting a person to maintain a blood glucose level between predetermined limits comprises an electronic device, for example a portable computing device such as a PDA, comprising a display, a clock, a memory, and a processor; and a software program executable by the processor of the electronic device, adapted to receive nutritional data of food consumed by the person, to calculate the blood glucose level for the person using the nutritional data and a glycemic response model for the person, and further adapted to present the blood glucose level to the person on the display of the electronic device. The program can receive diet log data from the person, for example food identities, then correlate the food identities with nutritional data using a database. The software program can be further adapted to receive time data related to the time of consumption of food (including beverages, nutraceuticals, and other consumables) by the person, and to receive data relating to planned consumption of food. Blood glucose levels can be calculated for a plurality of times, and presented as a table or graph. An activity monitor, in communication with the electronic device, can providing a signal correlated with a physical activity level of the person. An insulin delivery system, adapted to deliver insulin into the person by injection, infusion, aerosol, nasally, orally, using an implant, or any other method, can be in communication with the electronic device, so that the software program can initiate operation of the insulin delivery system, for example in response to projected blood glucose levels. A glucose sensor, in communication with the electronic device, can provide a signal correlated with the blood glucose level of the person. The glucose sensor can comprise at least one microneedle adapted to draw interstitial fluid from the person to a fluorescence sensor, so that the fluorescence sensor provides a fluorescence signal correlated with glucose concentration in the interstitial fluid; an analog-to-digital converter, providing a digital representation of the fluorescence signal; and a transmitter, adapted to transmit the digital representation of the fluorescence signal to an electronic device. The electronic device can comprises a wireless receiver, and the blood glucose sensor can comprise a wireless transmitter which transmits the digital representation of the fluorescence signal to the wireless receiver of the electronic device. The glucose sensor can comprises a fiber optically coupled to a fluorescence sensor in contact with lymph fluid, with interstitial fluid, or blood. Mault at [0042] Sensor 12 can be carried by the person and provides blood glucose measurements at intervals. For example, sensor 12 can uses ion flow to draw glucose molecules out of the blood into a gel disk containing the enzyme glucose oxidase, generating hydrogen peroxide, which is detected and a numerical

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	value displayed. This technique is used by GlucoWatch developed by Cygnus (Redwood City, Calif.). The sensor can then transmit the numerical value of blood glucose to the PDA 10, for example using a wireless method. Alternatively, sensor 12 may use spectroscopic detection of a glucose oxidase reaction. Sensor 12 may also use in-vivo spectroscopy techniques to measure blood glucose, for example as described in U.S. Pat. Nos. 6,067,463 (Jeng), 6,049,727 (Crothal), 5,660,163 (Schulman), and others. For example, IR absorption or reflection properties of skin or tissues may be determined, for example using a finger, toe, wrist, skin membrane, earlobe, nose, cheek, retina, or other body part. A blood analysis sensor may be built in to a module which plugs in to the PDA. For example, using a non-invasive spectroscopic technique, the PDA/module combination may be placed against part of the body to obtain a blood glucose reading. The sensor may also be placed under the skin, with wireless communication, such as using the Bluetooth protocol, to the PDA. The sensor may be powered by internal batteries, by light using a photoelectric effect, by temperature gradients using a thermoelectric effect, by radiation (e.g. from AM radio stations, electric mains, or radiated by the PDA or other portable device), and may be either continuously powered or only powered at times a reading is required. The sensor may record data to a memory card which plugs into the PDA. Mault at [0073] In one embodiment, the glucose sensor transmits the blood glucose level data to the PDA using a wireless communication protocol such as Bluetooth (Ericsson Components AB). Communication methods between sensor 12 and PDA 10 might include Bluetooth, IR transmission, IEEE 802.11(b), wireless Ethernet, optical methods, acoustic methods, or other wireless methods, or using a cable connection, electrical interface, or manual entry of data into the PDA using any input mechanism, such as keys, a stylus, voice recognition, and the like. The PDA may request a blood glucose reading from the sensor. Mault at [0074] In one embodiment, the system comprises a portable computing device such as a personal digital assistant (PDA), having a software program (such as a calorie management program or other health maintenance program) having a glycemic modeling capability, such as a glycemic response algorithm. The term PDA will be used for convenience to refer to a portable computing device. The software program can be adapted to receive blood glucose measurements of the person. Blood glucose levels can be determined by any convenient technique for comparison with the glycemic response predictions of the software program. The software program can be advantageously modified from the program described in U.S.

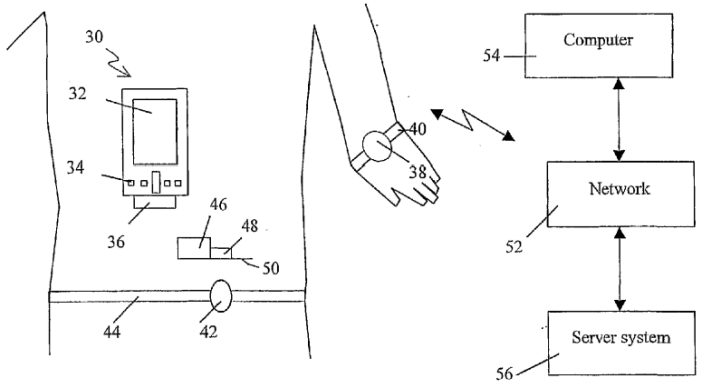
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	Provisional Application 60/240,185 to James R. Mault and others, so as to have a glycemic response algorithm, to record blood glucose levels, and to access a component response database by which the blood glucose response of a person to a meal can be determined by identifying meal components and determining the glycemic response of the person to the components. Diet logging methods are described in more detail later. Mault at [0014] FIG. 1 shows a schematic of a system embodiment comprising an electronic device 10, a blood glucose sensor 12, a physical activity monitor 14, an insulin pump 16, a communications network 20, and a remote computer system 22. Mault at [0069]  Figure 1 Mault at Fig. 1. Electronic device 10 can be carried by the person, for example a portable computer, personal digital assistant (PDA), wireless phone with computational functionality, visor-mounted device, or other device. The electronic device 10 can be a PDA such as a Palm Pilot. The electronic device can be a portable electronic device or system carried by the person, or a device or system combining multiple functionalities, such as: a personal digital assistant (PDA); an electronic book (e-book); a portable computer; any portable Internet access device; a wireless phone; a wristwatch, adapted to record data,

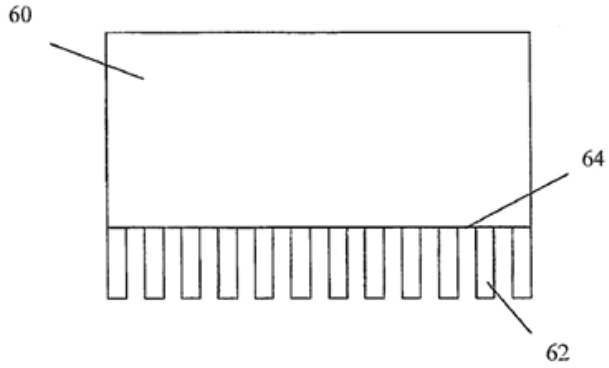
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	for example to monitor physiological properties, or act as a diet log (it may also act as a wireless internet access device, or be otherwise adapted); a headset, providing for example visual and audio communication to the person, and recording audio and/or visual information; a body mounted activity monitor (for example pedometer) adapted to record data; any portable electronic device with data logging capabilities, for example an electronic organizer; or some combination of the above or other devices. Mault at [0070]  Figure 2 Mault at Figs. 2 FIG. 2 shows a system embodiment, comprising portable computing device 30 having a display 32, data entry mechanism 34, and wireless transceiver 36; a wrist-mounted glucose sensor 38 having a strap 40; activity monitor 42 supported by the person's body using belt 44; insulin storage and dispensing device 46 comprising a subcutaneous needle 50 and delivery system 48 such as a pump. The portable computing device 30 is in linked to a communications network 52, allowing communication a remote computer system 54, which may be located at the person's home, doctor's office, or other remote location. A remote server system 56 is also accessible through the communications network 52, and can be used to store a database of physiological parameters, activity, and diet relating to the person, for medical, nutritional, or computer expert system analysis. The wrist mounted sensor 40 and activity monitor 42 can transmit data to the portable computing device 30 through a wireless method. The device 30 can be carried in a pocket of the person's clothes, or on a belt clip, or other convenient method.

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	Mault at [0079] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a] a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Mault discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] A system for controlling a blood glucose level of a person comprises: a blood glucose sensor, providing data correlated with the blood glucose level of the person; a computing device, having a display; a software program, running on the computing device, adapted to receive data from the blood glucose sensor, further adapted to receive food consumption data from the person, and further having an algorithm so as to display a blood glucose projection on the display. Mault at [0037]

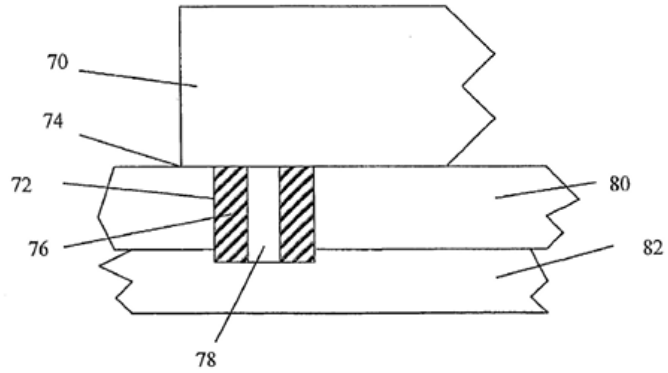
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	 Figure 2 Mault at Figs. 2 FIG. 2 shows a system embodiment, comprising portable computing device 30 having a display 32, data entry mechanism 34, and wireless transceiver 36; a wrist-mounted glucose sensor 38 having a strap 40; activity monitor 42 supported by the person's body using belt 44; insulin storage and dispensing device 46 comprising a subcutaneous needle 50 and delivery system 48 such as a pump. The portable computing device 30 is in linked to a communications network 52, allowing communication a remote computer system 54, which may be located at the person's home, doctor's office, or other remote location. A remote server system 56 is also accessible through the communications network 52, and can be used to store a database of physiological parameters, activity, and diet relating to the person, for medical, nutritional, or computer expert system analysis. The wrist mounted sensor 40 and activity monitor 42 can transmit data to the portable computing device 30 through a wireless method. The device 30 can be carried in a pocket of the person's clothes, or on a belt clip, or other convenient method. Mault at [0079] Functionalities of system elements can be combined. For example a wrist mounted device can combine the functionality of a glucose sensor and a portable computer. An earring-like device could combine the functionality of a glucose sensor and a device to give audible feedback to the person, perhaps as an extension of the PDA, and in for example Bluetooth wireless communication with it. The PDA may have a plug in module which analyzes blood. Other combinations are possible.

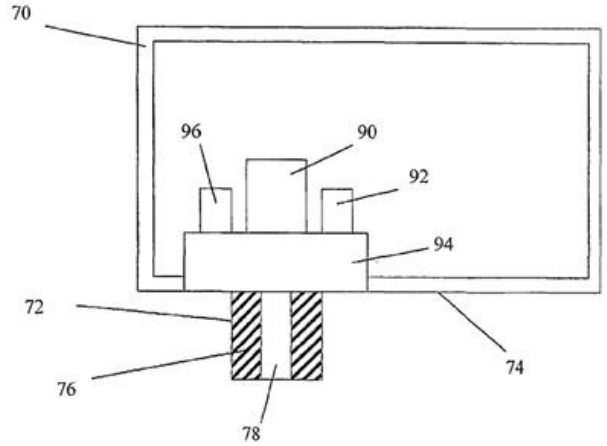
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	Mault at [0080] .  Figure 3 Mault at Figs. 3. FIG. 3 shows a blood glucose sensor housing 60 having a plurality of microneedles 62 projecting from a surface 64 of the housing 60. The microneedles 62 are hollow, and are of a length such that they penetrate through the outer layer of the skin of the person (through the epidermis), so that they are in contact with interstitial fluid below the outer layer of the epidermis. To reduce discomfort, the microneedles can be a length which does not penetrate the dermis. Mault at [0082]

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	 Figure 4 Mault at Figs. 4. FIG. 4 shows a surface 74 of a blood glucose sensor housing 70 resting against the surface of the skin of a person. For convenience, a single microneedle 72 is shown in cross section, having a wall 76 and a hollow center 78. The microneedle 72 is shown penetrating the epidermis 80 of the person, so as to locate the end of the microneedle below the epidermis 80. Skin layer 82 contains interstitial fluid, which may be analyzed. Interstitial fluid is then drawn up the microneedle 72 into the housing for analysis. To avoid disturbing nerve endings and blood vessels of the person, the needle should be short enough so as not to penetrate the dermis. Mault at [0084]

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	 Mault at Figs. 5. FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085] In one embodiment, interstitial fluid is drawn out of the dermis of the skin into an analysis means. Fluid can be drawn out of the skin through one or more inlet microneedles, and returned to the dermis through one or more outlet microneedles, so as to provide a flow of interstitial fluid through the module. The fluid can flow through an array of microspheres, such as silica or polymer microspheres, the surfaces of which have a molecular species which fluoresces in the presence of glucose. Alternatively, the fluid may flow through a capillary or microcapillary having an inside surface lined with a fluorescence film sensitive to the concentration of glucose in the fluid. The fluorescence is detected as a measure of glucose

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	concentration, using a detector and excitation radiation source (which can be located within the housing) possibly in comparison with a reference region not exposed to interstitial fluid flow. IR radiation may also be waveguided along capillaries, or scattered by microspheres, so as to spectroscopically detect glucose. In other embodiments, the analysis module uses the detection methods developed by Cygnus for the GlucoWatch, as discussed above. The module may alternatively draw blood or lymph fluid into the housing for analysis, for example using a micromechanical pump. The analysis module may alternatively perform non-invasive analysis of blood glucose, for example by clipping to an ear lobe or other skin flap and transmitting near-IR radiation through the skin flap. An analysis module with a fluorescence sensing region may be optically accessed by an external device having an excitation radiation source and a fluorescence detector, for example a fluorescence sensor can be contained within a transparent housing and embedded in the skin. Mault at [0094] The wrist-mounted device is adapted to monitor the blood glucose level of the wearer, for example using the methods and apparatus as described in U.S. Pat. Nos. 6,144,869 to Berner et al., 6,023,629 to Tamada, 5,989,409 to Kurnik et al., and 5,954,685 to Tierney, the contents of which are incorporated by reference. The wrist-mounted device is provided with a mechanism for drawing interstitial fluid out of the dermis into a medium, such as a gel or porous matrix, within the main housing, and a means for performing a test for blood glucose level using the fluid within the medium, for example the glucose oxidase reaction described in U.S. Pat. No. 5,108,819, herein incorporated by reference. Interstitial fluid can be withdrawn from the dermis using pressure, suction, capillary action, ion flow, peristalsis, osmotic flow, dialysis, heat treatment, abrasion, or other appropriate method. Analysis of the fluid for glucose concentration may use any convenient technique known in the art or described elsewhere in this specification. Mault at [0102] The display capability of the PDA is used in diet logging, diet planning, and glycemic response modeling, and a software program running on the PDA can be adapted to use data received from the wrist-mounted device. Also, data can be entered into the PDA and transmitted to the wrist-mounted device for use in glycemic response prediction. A PDA may communicate in a similar manner with other devices adapted to monitor blood glucose levels or otherwise be carried by the person, such as earrings, finger mounted devices, and other skin mounted monitors. Mault at [0103]

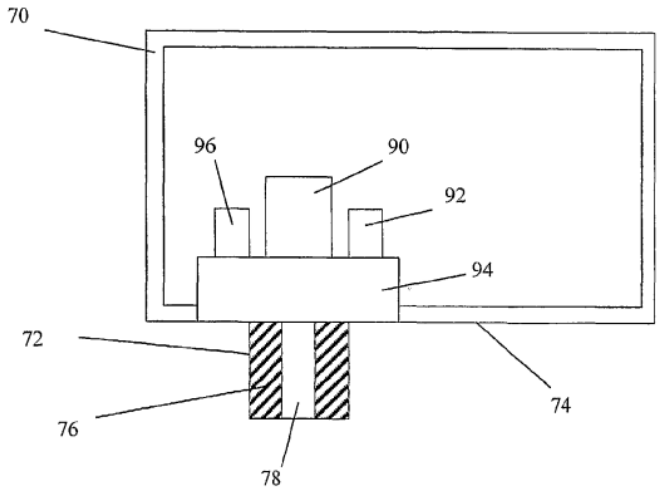
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	A PDA can also be used to monitor the physiological state of the person. It may communicate or otherwise receive data from physiological sensors or monitors carried by the person. It may also receive data from other physiological sensors or medical diagnostic equipment, for example devices located at a gym, doctors office, shopping mall, retail space, etc. The following methods or devices may be used: monitoring body fat proportion, for example using bioimpedance; monitoring skin resistance; monitoring blood component levels, for example glucose, oxygenation levels, carbonyl groups, ethanol, etc.; monitoring insulin, glucagon, or other hunger-related blood component levels, or other body products related to weight and metabolism, for example lactate, glycogen levels, epinephrine, norepinephrine, and thyroid hormone; monitoring levels of compounds related to long-term average blood glucose levels, for example glycohemoglobin levels in the blood; monitoring blood pressure; monitoring blood pH, carbonate ions, and ketone bodies in the blood (ketone body levels are related to fat metabolism, and monitoring is useful in a diet or exercise program); monitoring leptin levels, relating to satiety and obesity in humans; monitoring levels of uncoupling proteins (UCP1, UCP2), UCP regulating compounds, and analogs, which relate to metabolism; monitoring gastrointestinal hormones and hormone regulators, (for example cholecystokinin, gastrin, etc.), Mault at [0201] As part of a physiological monitoring system, a person may use one or more of the following methods: wearing a wristwatch-like device containing sensors; embedding or implanting sensors in the body; wearing patches on the skin; detecting color changes of elements in contact with the body; extracting and analyzing blood, for example using an automated device; wearing belt-mounted devices; wearing sensors mounted on a band circling some part of the body, wearing an earring or other body-piercing element adapted so as to monitor for example the blood; carrying a skin-mounted or belt-mounted sensor with the form and electrical connections of a non-volatile memory card (or “flash card”), such as manufactured by Sony, SanDisk, and others, which may also monitor physical activity; carrying microphones for example so as to monitor cardio-vascular noises; having electrodes contacting the skin, for example for bioimpedance analysis; and drawing blood and carrying out various analytical techniques, for example using enzymes. Mault at [0204] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

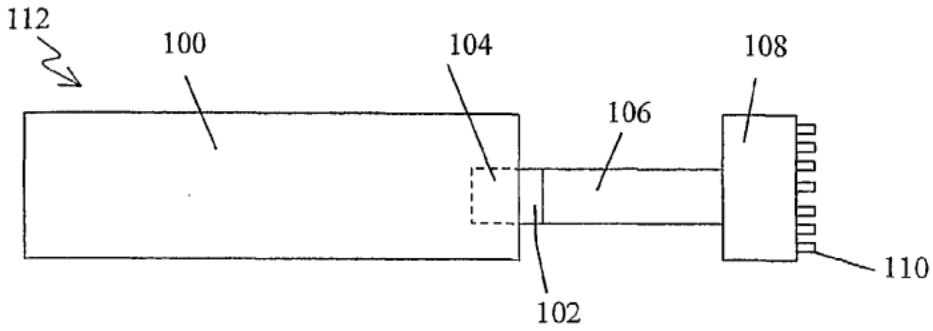
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'304 Patent	Mault
	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b] the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Mault discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085]

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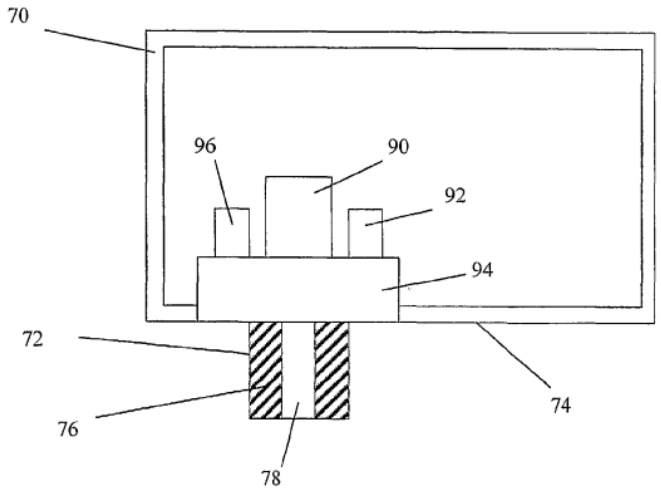
’304 Patent	Mault
	Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] In other embodiments, one or more optical fibers are used instead of or in addition to microneedles. The fibers have a length sufficient to penetrate the epidermis. A fluorescence sensing chemistry region is incorporated into the end of the fiber, so as to respond to the analyte of interest, such as glucose. For example, the end of the fiber may be a fluorophore-doped polymer permeable to the analyte of interest. Excitation radiation is passed down the fiber, so as to excite the fluorescent end of the fiber, and fluorescence is returned along the fiber to a detector. Optical filters can be used in addition to detectors. Mault at [0088]  Figure 5 Mault at Fig. 5.

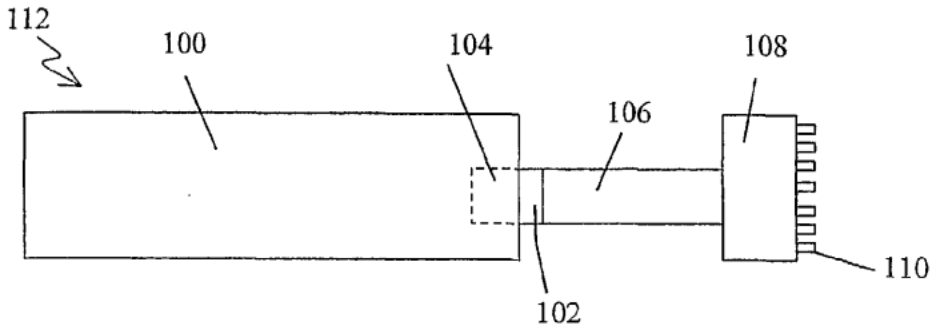
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’304 Patent	Mault
	FIG. 6 shows a microneedle module adapted to act as an accessory to a PDA. A microneedle array 110 is formed on one surface of the microneedle module 108, which is connected to an analysis module 106, the analysis module being connected to an interface 102 which plugs into a slot 104 within the housing 100 of PDA 112. At intervals, possibly alerted by the PDA, the person places the microneedle array against the skin allowing interstitial fluid to flow into the module. Analysis is performed within the analysis module, using any appropriate method. In one embodiment, the interstitial fluid is drawn into a gel layer, where it is analyzed for blood glucose using the conventional glucose oxidase reaction, or another analytical technique. Infrared and Raman spectroscopy can also be used for noninvasive analysis of blood glucose levels. A module may be placed against the skin to detect the IR signature of glucose of fluid beneath the skin, or a spectroscopic mechanism can be included into the analysis module described above so as to detect levels of glucose within the interstitial fluid extracted from the skin. Mault at [0089]  Figure 6 Mault at Fig. 6. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

’304 Patent	Mault
	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c] the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Mault discloses or renders obvious a the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085]

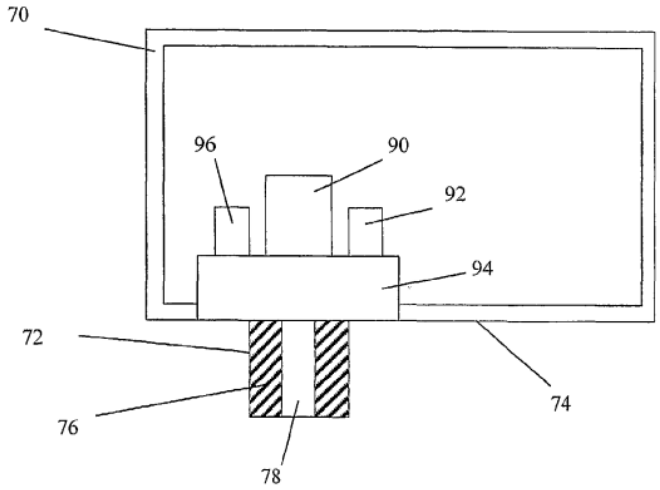
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	Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] In other embodiments, one or more optical fibers are used instead of or in addition to microneedles. The fibers have a length sufficient to penetrate the epidermis. A fluorescence sensing chemistry region is incorporated into the end of the fiber, so as to respond to the analyte of interest, such as glucose. For example, the end of the fiber may be a fluorophore-doped polymer permeable to the analyte of interest. Excitation radiation is passed down the fiber, so as to excite the fluorescent end of the fiber, and fluorescence is returned along the fiber to a detector. Optical filters can be used in addition to detectors. Mault at [0088]  Figure 5 Mault at Fig. 5.

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	FIG. 6 shows a microneedle module adapted to act as an accessory to a PDA. A microneedle array 110 is formed on one surface of the microneedle module 108, which is connected to an analysis module 106, the analysis module being connected to an interface 102 which plugs into a slot 104 within the housing 100 of PDA 112. At intervals, possibly alerted by the PDA, the person places the microneedle array against the skin allowing interstitial fluid to flow into the module. Analysis is performed within the analysis module, using any appropriate method. In one embodiment, the interstitial fluid is drawn into a gel layer, where it is analyzed for blood glucose using the conventional glucose oxidase reaction, or another analytical technique. Infrared and Raman spectroscopy can also be used for noninvasive analysis of blood glucose levels. A module may be placed against the skin to detect the IR signature of glucose of fluid beneath the skin, or a spectroscopic mechanism can be included into the analysis module described above so as to detect levels of glucose within the interstitial fluid extracted from the skin. Mault at [0089]  Figure 6 Mault at Fig. 6. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

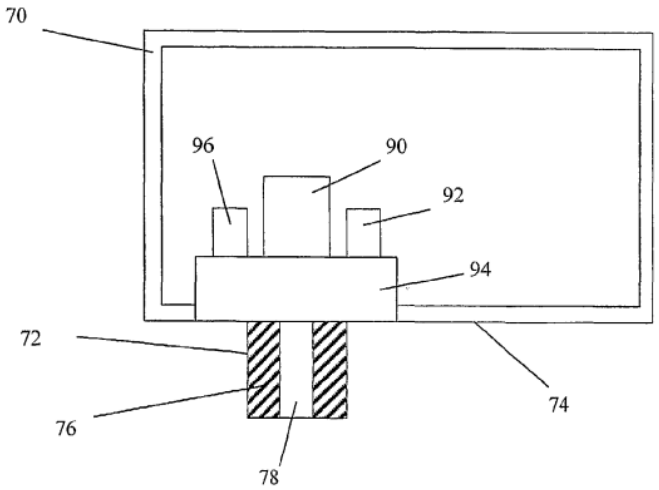
'304 Patent	Mault
	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d] the wearable measurement device further comprising a receiver configured to:	Mault discloses or renders obvious the wearable measurement device further comprising a receiver. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085]

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	 Figure 5 Mault at Fig. 5. Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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11[e] receive and process at least a portion of the analysis output beam reflected or transmitted from the sample,	Mault disloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] Sensor 12 can be carried by the person and provides blood glucose measurements at intervals. For example, sensor 12 can uses ion flow to draw glucose molecules out of the blood into a gel disk containing the enzyme glucose oxidase, generating hydrogen peroxide, which is detected and a numerical value displayed. This technique is used by GlucoWatch developed by Cygnus (Redwood City, Calif.). The sensor can then transmit the numerical value of blood glucose to the PDA 10, for example using a wireless method. Alternatively, sensor 12 may use spectroscopic detection of a glucose oxidase reaction. Sensor 12 may also use in-vivo spectroscopy techniques to measure blood glucose, for example as described in U.S. Pat. Nos. 6,067,463 (Jeng), 6,049,727 (Crothal), 5,660,163 (Schulman), and others. For example, IR absorption or reflection properties of skin or tissues may be determined, for example using a finger, toe, wrist, skin membrane, earlobe, nose, cheek, retina, or other body part. A blood analysis sensor may be built in to a module which plugs in to the PDA. For example, using a non-invasive spectroscopic technique, the PDA/module combination may be placed against part of the body to obtain a blood glucose reading. The sensor may also be placed under the skin, with wireless communication, such as using the Bluetooth protocol, to the PDA. The sensor may be powered by internal batteries, by light using a photoelectric effect, by temperature gradients using a thermoelectric effect, by radiation (e.g. from AM radio stations, electric mains, or radiated by the PDA or other portable device), and may be either continuously powered or only powered at times a reading is required. The sensor may record data to a memory card which plugs into the PDA.

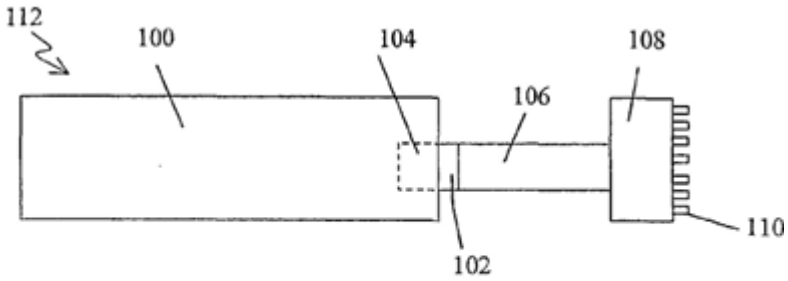
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	Mault at [0073] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085]  Figure 5 Mault at Fig. 5.

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	Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] Analytical techniques which may be used to measure glucose concentrations in blood, interstitial fluid, urine, or other body fluids and tissues include: techniques based on the glucose oxidase reaction; other enzymatic reactions; IR (particularly near-IR), Raman, and optical-UV spectroscopy; fluorescence; colorimetry; attenuated total reflection, for example from a surface adapted to bind glucose; micromechanical methods such as detecting changes in resonance frequencies on analyte absorption, or having surfaces adapted to bind glucose with other detection methods; optical rotation and ORD; refractometry; fiber sensing; laser absorption; enzymatic methods such as using the glucose oxidase reaction; biochemical effect detection; or other appropriate techniques. Fluid samples may be removed from the body, or analyzed within the body. Mault at [0090] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f] generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Mault discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. The electronic device can comprises a wireless receiver, and the blood glucose sensor can comprise a wireless transmitter which transmits the digital representation of the fluorescence signal to the wireless receiver of the electronic device. The glucose sensor can comprises a fiber optically coupled to a fluorescence sensor in contact with lymph fluid, with interstitial fluid, or blood.

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	[0042] Sensor 12 can be carried by the person and provides blood glucose measurements at intervals. For example, sensor 12 can uses ion flow to draw glucose molecules out of the blood into a gel disk containing the enzyme glucose oxidase, generating hydrogen peroxide, which is detected and a numerical value displayed. This technique is used by GlucoWatch developed by Cygnus (Redwood City, Calif.). The sensor can then transmit the numerical value of blood glucose to the PDA 10, for example using a wireless method. Alternatively, sensor 12 may use spectroscopic detection of a glucose oxidase reaction. Sensor 12 may also use in-vivo spectroscopy techniques to measure blood glucose, for example as described in U.S. Pat. Nos. 6,067,463 (Jeng), 6,049,727 (Crothal), 5,660,163 (Schulman), and others. For example, IR absorption or reflection properties of skin or tissues may be determined, for example using a finger, toe, wrist, skin membrane, earlobe, nose, cheek, retina, or other body part. A blood analysis sensor may be built in to a module which plugs in to the PDA. For example, using a non-invasive spectroscopic technique, the PDA/module combination may be placed against part of the body to obtain a blood glucose reading. The sensor may also be placed under the skin, with wireless communication, such as using the Bluetooth protocol, to the PDA. The sensor may be powered by internal batteries, by light using a photoelectric effect, by temperature gradients using a thermoelectric effect, by radiation (e.g. from AM radio stations, electric mains, or radiated by the PDA or other portable device), and may be either continuously powered or only powered at times a reading is required. The sensor may record data to a memory card which plugs into the PDA. Mault at [0073]

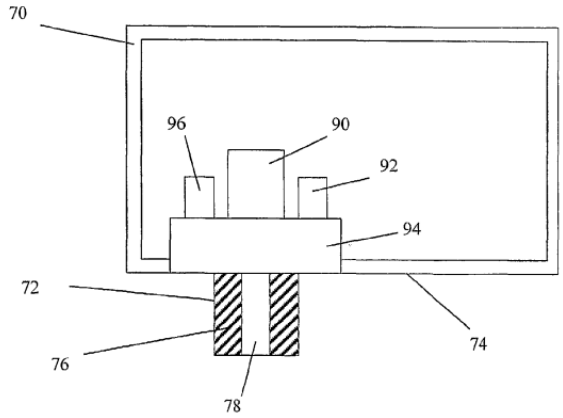
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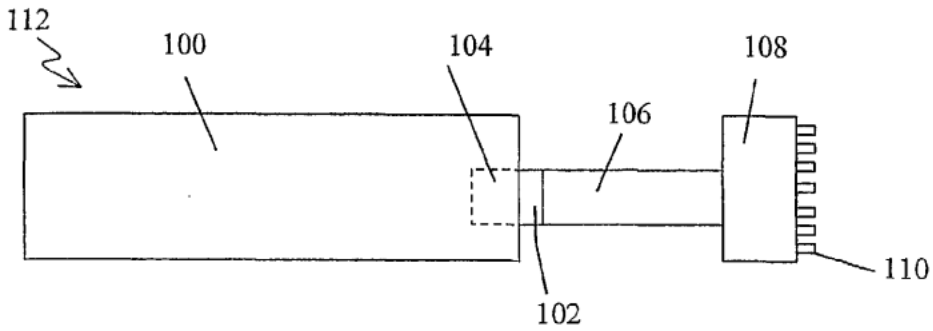
’304 Patent	Mault
	 Figure 6 Mault at Fig.6. FIG. 6 shows a microneedle module adapted to act as an accessory to a PDA. A microneedle array 110 is formed on one surface of the microneedle module 108, which is connected to an analysis module 106, the analysis module being connected to an interface 102 which plugs into a slot 104 within the housing 100 of PDA 112. At intervals, possibly alerted by the PDA, the person places the microneedle array against the skin allowing interstitial fluid to flow into the module. Analysis is performed within the analysis module, using any appropriate method. In one embodiment, the interstitial fluid is drawn into a gel layer, where it is analyzed for blood glucose using the conventional glucose oxidase reaction, or another analytical technique. Infrared and Raman spectroscopy can also be used for noninvasive analysis of blood glucose levels. A module may be placed against the skin to detect the IR signature of glucose of fluid beneath the skin, or a spectroscopic mechanism can be included into the analysis module described above so as to detect levels of glucose within the interstitial fluid extracted from the skin. Mault at [0089] In one embodiment, interstitial fluid is drawn out of the dermis of the skin into an analysis means. Fluid can be drawn out of the skin through one or more inlet microneedles, and returned to the dermis through one or more outlet microneedles, so as to provide a flow of interstitial fluid through the module. The fluid can flow through an array of microspheres, such as silica or polymer microspheres, the surfaces of which have a molecular species which fluoresces in the presence of glucose. Alternatively, the fluid may

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	flow through a capillary or microcapillary having an inside surface lined with a fluorescence film sensitive to the concentration of glucose in the fluid. The fluorescence is detected as a measure of glucose concentration, using a detector and excitation radiation source (which can be located within the housing) possibly in comparison with a reference region not exposed to interstitial fluid flow. IR radiation may also be waveguided along capillaries, or scattered by microspheres, so as to spectroscopically detect glucose. In other embodiments, the analysis module uses the detection methods developed by Cygnus for the GlucoWatch, as discussed above. The module may alternatively draw blood or lymph fluid into the housing for analysis, for example using a micromechanical pump. The analysis module may alternatively perform non-invasive analysis of blood glucose, for example by clipping to an ear lobe or other skin flap and transmitting near-IR radiation through the skin flap. An analysis module with a fluorescence sensing region may be optically accessed by an external device having an excitation radiation source and a fluorescence detector, for example a fluorescence sensor can be contained within a transparent housing and embedded in the skin. Mault at [0094] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g] synchronize to the light source,	Mault discloses or renders obvious the receiver configured to synchronize to the light source. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and

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	improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h] capture light while the semiconductor sources are off and convert the captured light into a first signal,	Mault discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from

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	entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085]  Figure 5 Mault at Fig. 5. Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] In other embodiments, one or more optical fibers are used instead of or in addition to microneedles. The fibers have a length sufficient to penetrate the epidermis. A fluorescence sensing chemistry region is incorporated into the end of the fiber, so as to respond to the analyte of interest, such as glucose. For example, the end of the fiber may be a fluorophore-doped polymer permeable to the analyte of interest.

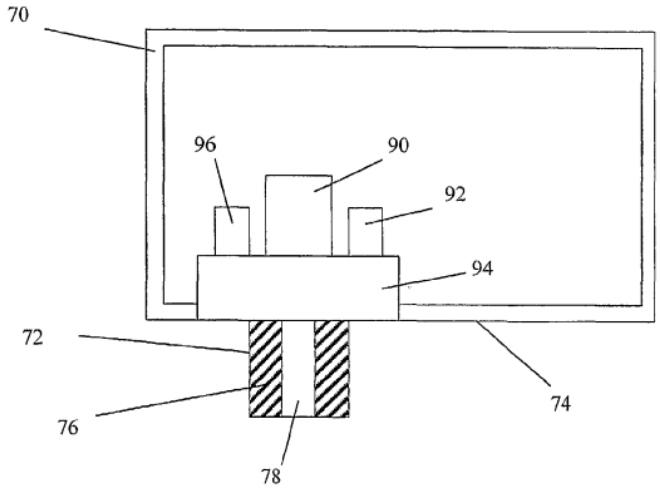
’304 Patent	Mault
	Excitation radiation is passed down the fiber, so as to excite the fluorescent end of the fiber, and fluorescence is returned along the fiber to a detector. Optical filters can be used in addition to detectors. Mault at [0088] FIG. 6 shows a microneedle module adapted to act as an accessory to a PDA. A microneedle array 110 is formed on one surface of the microneedle module 108, which is connected to an analysis module 106, the analysis module being connected to an interface 102 which plugs into a slot 104 within the housing 100 of PDA 112. At intervals, possibly alerted by the PDA, the person places the microneedle array against the skin allowing interstitial fluid to flow into the module. Analysis is performed within the analysis module, using any appropriate method. In one embodiment, the interstitial fluid is drawn into a gel layer, where it is analyzed for blood glucose using the conventional glucose oxidase reaction, or another analytical technique. Infrared and Raman spectroscopy can also be used for noninvasive analysis of blood glucose levels. A module may be placed against the skin to detect the IR signature of glucose of fluid beneath the skin, or a spectroscopic mechanism can be included into the analysis module described above so as to detect levels of glucose within the interstitial fluid extracted from the skin. Mault at [0089]  Figure 6

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	Mault at Fig. 6. In one embodiment, interstitial fluid is drawn out of the dermis of the skin into an analysis means. Fluid can be drawn out of the skin through one or more inlet microneedles, and returned to the dermis through one or more outlet microneedles, so as to provide a flow of interstitial fluid through the module. The fluid can flow through an array of microspheres, such as silica or polymer microspheres, the surfaces of which have a molecular species which fluoresces in the presence of glucose. Alternatively, the fluid may flow through a capillary or microcapillary having an inside surface lined with a fluorescence film sensitive to the concentration of glucose in the fluid. The fluorescence is detected as a measure of glucose concentration, using a detector and excitation radiation source (which can be located within the housing) possibly in comparison with a reference region not exposed to interstitial fluid flow. IR radiation may also be waveguided along capillaries, or scattered by microspheres, so as to spectroscopically detect glucose. In other embodiments, the analysis module uses the detection methods developed by Cygnus for the GlucoWatch, as discussed above. The module may alternatively draw blood or lymph fluid into the housing for analysis, for example using a micromechanical pump. The analysis module may alternatively perform non-invasive analysis of blood glucose, for example by clipping to an ear lobe or other skin flap and transmitting near-IR radiation through the skin flap. An analysis module with a fluorescence sensing region may be optically accessed by an external device having an excitation radiation source and a fluorescence detector, for example a fluorescence sensor can be contained within a transparent housing and embedded in the skin. Mault at [0094] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i] capture light while at least one of the semiconductor sources is on and convert the captured	Mault discloses or renders obvious the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample.

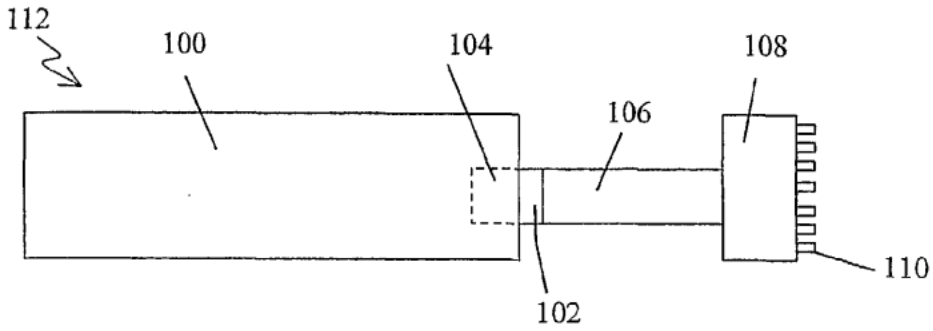
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light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085]

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	 Figure 5 Mault at Fig. 5. Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] In other embodiments, one or more optical fibers are used instead of or in addition to microneedles. The fibers have a length sufficient to penetrate the epidermis. A fluorescence sensing chemistry region is incorporated into the end of the fiber, so as to respond to the analyte of interest, such as glucose. For example, the end of the fiber may be a fluorophore-doped polymer permeable to the analyte of interest. Excitation radiation is passed down the fiber, so as to excite the fluorescent end of the fiber, and fluorescence is returned along the fiber to a detector. Optical filters can be used in addition to detectors. Mault at [0088]

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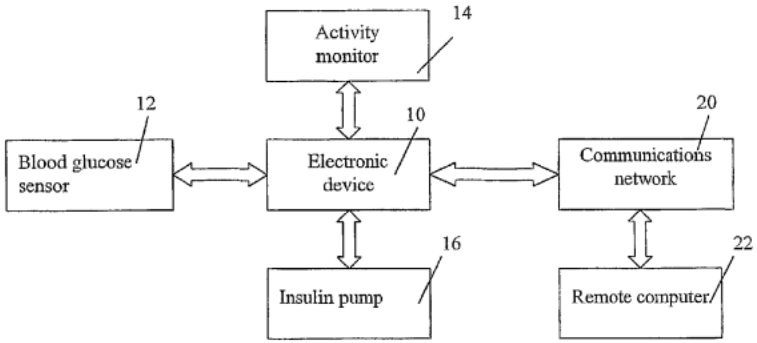
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	FIG. 6 shows a microneedle module adapted to act as an accessory to a PDA. A microneedle array 110 is formed on one surface of the microneedle module 108, which is connected to an analysis module 106, the analysis module being connected to an interface 102 which plugs into a slot 104 within the housing 100 of PDA 112. At intervals, possibly alerted by the PDA, the person places the microneedle array against the skin allowing interstitial fluid to flow into the module. Analysis is performed within the analysis module, using any appropriate method. In one embodiment, the interstitial fluid is drawn into a gel layer, where it is analyzed for blood glucose using the conventional glucose oxidase reaction, or another analytical technique. Infrared and Raman spectroscopy can also be used for noninvasive analysis of blood glucose levels. A module may be placed against the skin to detect the IR signature of glucose of fluid beneath the skin, or a spectroscopic mechanism can be included into the analysis module described above so as to detect levels of glucose within the interstitial fluid extracted from the skin. Mault at [0089]  Figure 6 Mault at Fig. 6. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

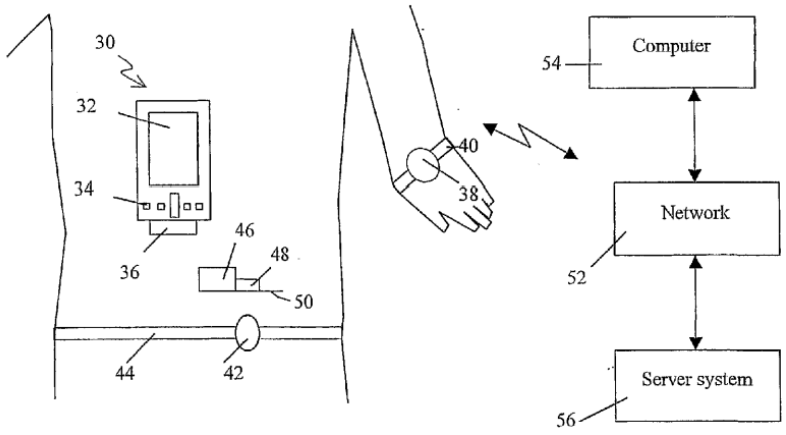
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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j] wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Mault discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	Mault discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. In one embodiment, the system comprises a portable computing device such as a personal digital assistant (PDA), having a software program (such as a calorie management program or other health maintenance program) having a glycemic modeling capability, such as a glycemic response algorithm. The term PDA will be used for convenience to refer to a portable computing device. The software program can be adapted to receive blood glucose measurements of the person. Blood glucose levels can be determined by any convenient technique for comparison with the glycemic response predictions of the software program. The software program can be advantageously modified from the program described in U.S. Provisional Application 60/240,185 to James R. Mault and others, so as to have a glycemic response algorithm, to record blood glucose levels, and to access a component response database by which the blood glucose response of a person to a meal can be determined by identifying meal components and determining the glycemic response of the person to the components. Diet logging methods are described in more detail later.

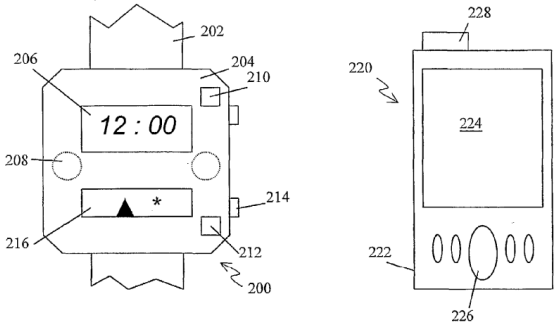
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	Mault at [0014] A system for assisting a person to maintain a blood glucose level between predetermined limits comprises an electronic device, for example a portable computing device such as a PDA, comprising a display, a clock, a memory, and a processor; and a software program executable by the processor of the electronic device, adapted to receive nutritional data of food consumed by the person, to calculate the blood glucose level for the person using the nutritional data and a glycemic response model for the person, and further adapted to present the blood glucose level to the person on the display of the electronic device. The program can receive diet log data from the person, for example food identities, then correlate the food identities with nutritional data using a database. The software program can be further adapted to receive time data related to the time of consumption of food (including beverages, nutraceuticals, and other consumables) by the person, and to receive data relating to planned consumption of food. Blood glucose levels can be calculated for a plurality of times, and presented as a table or graph. An activity monitor, in communication with the electronic device, can providing a signal correlated with a physical activity level of the person. An insulin delivery system, adapted to deliver insulin into the person by injection, infusion, aerosol, nasally, orally, using an implant, or any other method, can be in communication with the electronic device, so that the software program can initiate operation of the insulin delivery system, for example in response to projected blood glucose levels. A glucose sensor, in communication with the electronic device, can provide a signal correlated with the blood glucose level of the person. The glucose sensor can comprise at least one microneedle adapted to draw interstitial fluid from the person to a fluorescence sensor, so that the fluorescence sensor provides a fluorescence signal correlated with glucose concentration in the interstitial fluid; an analog-to-digital converter, providing a digital representation of the fluorescence signal; and a transmitter, adapted to transmit the digital representation of the fluorescence signal to an electronic device. The electronic device can comprises a wireless receiver, and the blood glucose sensor can comprise a wireless transmitter which transmits the digital representation of the fluorescence signal to the wireless receiver of the electronic device. The glucose sensor can comprises a fiber optically coupled to a fluorescence sensor in contact with lymph fluid, with interstitial fluid, or blood. Mault at [0042] FIG. 1 shows a schematic of a system embodiment comprising an electronic device 10, a blood glucose sensor 12, a physical activity monitor 14, an insulin pump 16, a communications network 20, and a remote computer system 22.

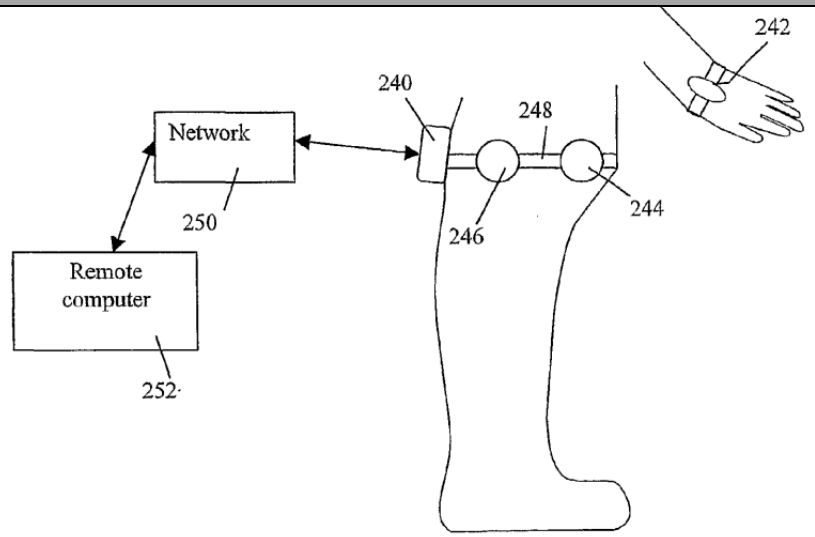
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	Mault at [0069]  Figure 1 Mault at Fig. 1. Remote computer system 22 may be a remote server, physicians computer, home computer, or other computer system accessible over the communications network 20. The PDA can access the communications network, such as the Internet, using a wireless connection. Data can be transferred to the remote system over the communications network 20, allowing examination by a dietician, physician, other specialist, or by the person themselves using the PDA or any computer. Feedback, generated by a specialist or computer expert system, may be transmitted to the PDA from the remote computer over the communications network. In an emergency situation, the PDA may send out a request for medical assistance. A global positioning system (GPS) may also be added to the PDA, to facilitate medical rescue in an emergency. Mault at [0077]

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	 Figure 2 Mault at Fig. 2. FIG. 2 shows a system embodiment, comprising portable computing device 30 having a display 32, data entry mechanism 34, and wireless transceiver 36; a wrist-mounted glucose sensor 38 having a strap 40; activity monitor 42 supported by the person's body using belt 44; insulin storage and dispensing device 46 comprising a subcutaneous needle 50 and delivery system 48 such as a pump. The portable computing device 30 is in linked to a communications network 52, allowing communication a remote computer system 54, which may be located at the person's home, doctor's office, or other remote location. A remote server system 56 is also accessible through the communications network 52, and can be used to store a database of physiological parameters, activity, and diet relating to the person, for medical, nutritional, or computer expert system analysis. The wrist mounted sensor 40 and activity monitor 42 can transmit data to the portable computing device 30 through a wireless method. The device 30 can be carried in a pocket of the person's clothes, or on a belt clip, or other convenient method. Mault at [0079]

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	 Figure 8 Mault at Fig. 8. FIG. 8 shows a wrist-mounted device 200 having a strap 202; housing 204; display 206; electrodes on the rear surface 208 for interstitial fluid extraction, with corresponding fluid analysis functionality within the housing; a barcode scanner 210; an IR port 212, for communication with a PDA or other device; and a graphics display 216. Buttons such as 214 are provided for setting the time, mode changes, and the like. The IR port allows communication with PDA 220. The PDA 220 has housing 222, a display 224, data entry mechanism 226, and an IR port 228. Other wireless communication methods, such as the Bluetooth protocol, or a cable link, can be used between the wrist mounted device and the PDA. Mault at [0101]

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	 Figure 9 Mault at Fig. 9. Communication between the PDA and the remote computer system 252 can be using a wireless connection to a communications network 250, such as the Internet, so that the data collected by the PDA can be transmitted for example to a web site accessible by a physician. In other embodiments, all portable system elements are carried on a belt, and the belt provides communication between system elements for example using integrated cables. A battery can also be carried by or built into the belt. Mault at [0105] The electronic device 240 is used as a diet log and to store blood glucose readings. The device provides dietary feedback to the mother based on a measured and modeled (or estimated) glycemic response. The device also collects data from physiological sensors monitoring the health of the baby and/or mother. An audible alert can sound if projected or actual blood glucose levels deviate from a predetermined range. Mault at [0106] The PDA may also be used to keep a diet log for the person over an extended period of time, for example one month, during which blood glucose readings are made at appropriate intervals, for example every

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	half-hour, perhaps more frequently just after a meal. The glycemic response of the person can then be calculated from the blood glucose readings and the recorded diet log using multi-parameter fits. The response to different meals will overlap in the blood glucose response over time, but using data fitting techniques, the responses to different meals may be resolved, particularly if the same meal is consumed on several different days. The response to a meal may then be broken down into the response to individual components, particularly if the same component occurs in different meals. The fitting of the overall glycemic response data to modeled responses to individual meals, and then possibly to responses due to meal components, is an example of a multi-parameter fit to the glycemic response data. Mault at [0129] Data may be received by the PDA using any convenient method, for example wireless communication (for example Bluetooth), IR beams, wires, cables, electrical interfaces, data storage media transfer, voice entry, manual entry (for example using keys or stylus), etc. Sensors may be part of the PDA, in which case signals would be received by connections contained within the housing of the PDA. Data may be received in continuously, in real time, or at periodic intervals. The PDA may prompt a sensor to send data. Mault at [0199] A PDA can also be used to monitor the physiological state of the person. It may communicate or otherwise receive data from physiological sensors or monitors carried by the person. It may also receive data from other physiological sensors or medical diagnostic equipment, for example devices located at a gym, doctors office, shopping mall, retail space, etc. The following methods or devices may be used: monitoring body fat proportion, for example using bioimpedance; monitoring skin resistance; monitoring blood component levels, for example glucose, oxygenation levels, carbonyl groups, ethanol, etc.; monitoring insulin, glucagon, or other hunger-related blood component levels, or other body products related to weight and metabolism, for example lactate, glycogen levels, epinephrine, norepinephrine, and thyroid hormone; monitoring levels of compounds related to long-term average blood glucose levels, for example glycohemoglobin levels in the blood; monitoring blood pressure; monitoring blood pH, carbonate ions, and ketone bodies in the blood (ketone body levels are related to fat metabolism, and monitoring is useful in a diet or exercise program); monitoring leptin levels, relating to satiety and obesity in humans; monitoring levels of uncoupling proteins (UCP1, UCP2), UCP regulating compounds, and analogs, which relate to metabolism; monitoring gastrointestinal hormones and hormone regulators, (for

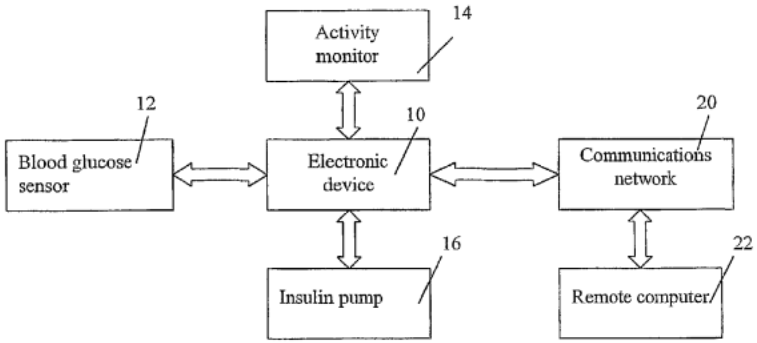
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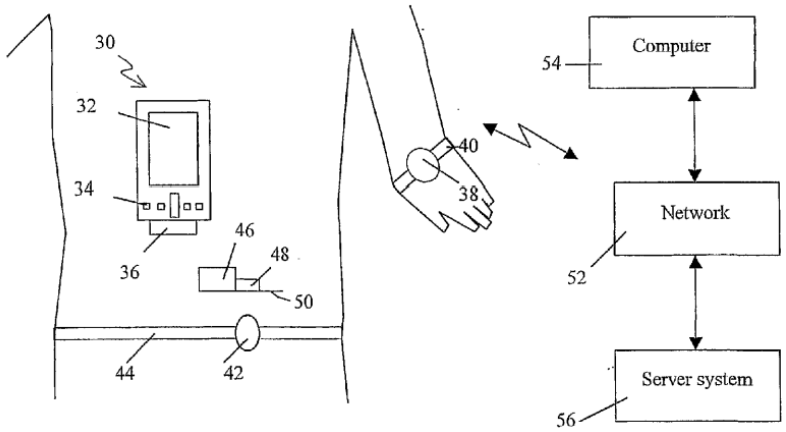
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	example cholecystokinin, gastrin, etc.), and antibody/antagonist levels, which relate to digestion efficiency; monitoring the blood for disease-related components, for example liver enzymes, which relate to liver disease; monitoring the blood for products of protein metabolism, such as nitrogen-containing compounds for example urea (as protein metabolism is generally unwelcome in for example weight control programs as it leads to muscle loss and a decrease in resting metabolic rate); monitoring the blood for pathogens for example bacteria, viruses, protazoans, and/or antibodies to them; monitoring the blood for parasites, for example merozoites (malaria); monitoring the blood for viruses (and/or antibodies) related to obesity, for example adenoviruses such as Ad-36; monitoring vitamin, mineral, and electrolyte levels; monitoring pulse rate; monitoring respiratory volume, for example using abdominal expansion, acoustic monitoring, or a spirometer; monitoring for respiration abnormalities, for an awake or asleep person, for example monitoring sleep apnea; monitoring exhaled air for evidence of lung infection or disease; monitoring hydrogen levels in exhaled air, which relates to digestion efficiency; performing respiratory analysis, for example for oxygen consumption, or exhalation of carbon dioxide, ketones, aldehydes, nitric oxide, ammonia, other nitrogen-containing compounds, peroxides, sulfur-containing compounds, esters, or other volatile organic compounds, which may be symptomatic of diabetes, liver misfunction, kidney misfunction, etc.; respiratory monitoring of acetone to indicate the onset of fat burning in a diet and/or exercise program, or to indicate diabetic symptoms; respiratory monitoring of nitric oxide (NO) as indicator of inflammatory airway diseases (for example asthma), for example as described in U.S. Pat. No. 6,010,459; respiratory monitoring of isotopically labeled gases, for example due to the metabolism of labeled compounds, for example as in U.S. Pat. No. 5,962,335; monitoring brain activity (brain waves), and using the physiological effects of thinking to control devices (for example U.S. Pat. No. 6,024,700); monitoring the heart, using for example using electrocardiograms, acoustic monitoring, etc., also forming correlations between data sets, filtering, signal processing, etc.; monitoring body temperature; monitoring skin temperature, this may decrease at the extremities in some physiological conditions; monitoring physiological indications of eating, for example blood glucose, body temperature, swallowing, etc. which may assist diet logging; monitoring posture, for example using ultrasonic transducers which determine distances between each other, which can also be used to monitor physical activity; monitoring time awake, or time asleep; monitoring time engaged in a specific activity (occupational or recreational), for example driving, operating equipment, walking, running, other exercise, typing, etc., using one or more physiological states; measuring body weight, for example using scales in communication with the PDA, or entering data into the PDA; monitoring skin pallor (for surface blood flow estimation, this reduces in hypoglycemic state); receiving data from other analytical or testing devices; monitoring response to electrostimulation, particularly at the extremities (this reduces in hypoglycemia); recording emotion (for example heartbeat, facial muscle state, stress hormone level);

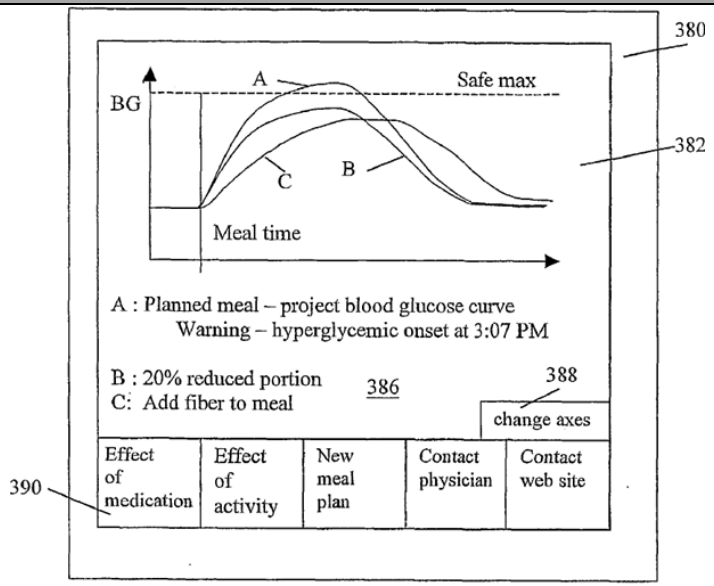
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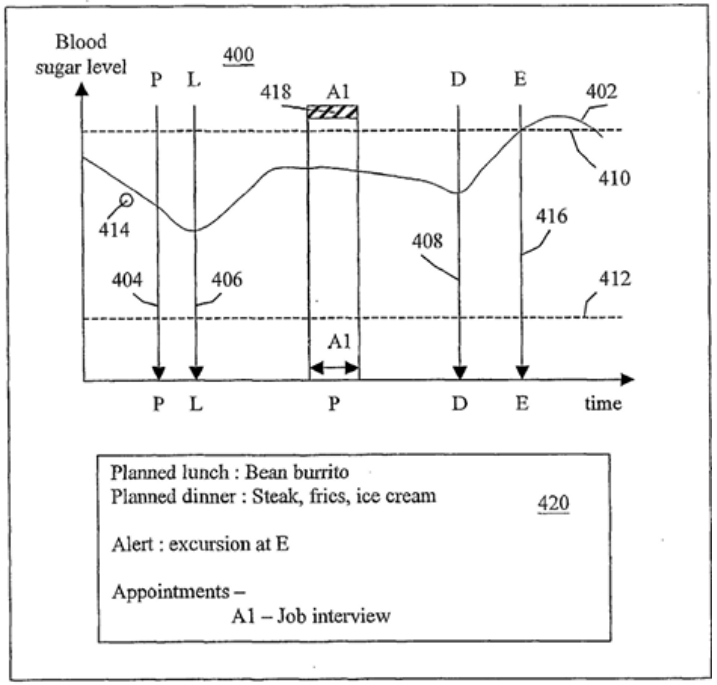
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	monitoring hormone levels in the blood; monitoring perspiration level; performing perspiration analysis; transmitting physiologic data to a physician, nutritionist, dietician, fitness consultant, or other professional, using for example a wireless Internet connection, for example transmitting data at periodic intervals or on demand from the PDA to a database on a remote (i.e. not carried by the person) computer which may be accessed by authorized persons; performing urine analysis (for example for quantifying nitrogen metabolism, estimating protein intake, etc.); monitoring metabolic rate, for example using an indirect calorimeter; monitoring bone density, for example using ultrasonic transducers mounted on the skin using an adhesive clip and/or acoustic impedance matching gel (the person may be prompted to take calcium supplements if bone density falls below a certain level); searching for tumor markers; detecting gene sequences; and monitoring pupil dilation. Further, hydration level can be monitored. For example, the current Handspring Visor, or similar device, may be provided with a frame plugging into the Springboard slot, with four electrodes projecting from the frame, and appropriate electronic circuitry provided for bioimpedance analysis of the person's body. Bioimpedance data may be used to determine body fat content, and can also be used to monitor short-term hydration level changes, over time periods during which body fat proportion would not be expected to change. Dehydration is known to sometimes stimulate the appetite. Mault at [0201] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and	Mault discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. FIG. 1 shows a schematic of a system embodiment comprising an electronic device 10, a blood glucose sensor 12, a physical activity monitor 14, an insulin pump 16, a communications network 20, and a remote computer system 22.

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to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Mault at [0069]  Figure 1 Mault at Fig. 1. Remote computer system 22 may be a remote server, physicians computer, home computer, or other computer system accessible over the communications network 20. The PDA can access the communications network, such as the Internet, using a wireless connection. Data can be transferred to the remote system over the communications network 20, allowing examination by a dietician, physician, other specialist, or by the person themselves using the PDA or any computer. Feedback, generated by a specialist or computer expert system, may be transmitted to the PDA from the remote computer over the communications network. In an emergency situation, the PDA may send out a request for medical assistance. A global positioning system (GPS) may also be added to the PDA, to facilitate medical rescue in an emergency. Mault at [0077] FIG. 2 shows a system embodiment, comprising portable computing device 30 having a display 32, data entry mechanism 34, and wireless transceiver 36; a wrist-mounted glucose sensor 38 having a strap 40; activity monitor 42 supported by the person's body using belt 44; insulin storage and dispensing device 46 comprising a subcutaneous needle 50 and delivery system 48 such as a pump. The portable computing device 30 is in linked to a communications network 52, allowing communication a remote computer

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	system 54, which may be located at the person's home, doctor's office, or other remote location. A remote server system 56 is also accessible through the communications network 52, and can be used to store a database of physiological parameters, activity, and diet relating to the person, for medical, nutritional, or computer expert system analysis. The wrist mounted sensor 40 and activity monitor 42 can transmit data to the portable computing device 30 through a wireless method. The device 30 can be carried in a pocket of the person's clothes, or on a belt clip, or other convenient method. Mault at [0079]  Figure 2 Mault at Fig. 2. Communication between the PDA and the remote computer system 252 can be using a wireless connection to a communications network 250, such as the Internet, so that the data collected by the PDA can be transmitted for example to a web site accessible by a physician. In other embodiments, all portable system elements are carried on a belt, and the belt provides communication between system elements for example using integrated cables. A battery can also be carried by or built into the belt. Mault at [0105]

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	 Figure 14 Mault at Fig. 14. FIG. 14 illustrates possible feedback to the person from the display 382 of an electronic device 380, such as a PDA. The modeled glycemic response of a person allows blood glucose levels to be projected at times beyond the consumption of a meal, or number of meals, using for example a software program having blood glucose prediction functionality. The graph 386 shows three projected blood glucose curves, labeled A (corresponding to a planned meal), B (corresponding to a reduced portion size), and C (corresponding to addition of fiber to the meal). Curve A leads to an excursion of blood glucose above a predetermined safe maximum level. Curves B and C can be generated by the computer so as to present health alternative meal plans which avoid blood glucose level excursions. Option selectors 390 allow the person to investigate the effects of medication (such as insulin), activity (such as exercise), and new meal plans (such as modified recipes) on the effect of projected blood glucose. The person can also contact a medical professional (for example, if serious problems are projected), or receive advice from a web site accessible over a communications network. Option selector 388 allows the person to view the graph on a different scale, otherwise modify the graphical presentation, obtain tabular data, or plot long term blood glucose averages.

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	Mault at [0134]  Figure 15 Mault at Fig. 15. FIG. 15 shows a possible presentation on a screen or display of a computing device used to provide feedback to the person. Within the top half of the screen, a graph or chart 400 shows a curve 402, which represents the calculated blood glucose level for the person as a function of time. The current present) time P is indicated by arrow 404. Projected future levels of blood glucose are calculated using a glycemic response model, and are presented to the right of the arrow 404. The person has entered a planned lunch (L) and dinner (D), indicated at times shown using arrows 406 and 408 respectively. The nutritional content of these planned meals is used to calculate future values of blood glucose. As a result of the entered meals, the curve exceeds the upper recommended blood glucose level, shown by dotted line 410, after the planned dinner at a time E, shown by arrow 416. The previous accuracy of the model's

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	predictions has been checked using a data point (414) which represents an actual blood glucose measurement for the person. As this point 414 is close to the curve based on previous food and blood glucose entries, the model is assumed to be accurate. If discrepancies are present, the curve can be shifted, the predictive algorithm modified, or the person recommended to perform more frequent blood glucose measurements. An appointment is indicated by region A1 at 418. Window 420 shows a summary of meals planned, and an alert regarding the blood glucose level excursion. Colors can be used to highlight events, such as appointments, the curve 402, and possibly also to highlight periods of time when the curve 402 goes outside the predetermined range bounded by upper limit 410 and lower limit 412. Mault at [0136] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mault discloses or renders obvious the measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. Remote computer system 22 may be a remote server, physicians computer, home computer, or other computer system accessible over the communications network 20. The PDA can access the communications network, such as the Internet, using a wireless connection. Data can be transferred to the remote system over the communications network 20, allowing examination by a dietician, physician, other specialist, or by the person themselves using the PDA or any computer. Feedback, generated by a specialist or computer expert system, may be transmitted to the PDA from the remote computer over the communications network. In an emergency situation, the PDA may send out a request for medical assistance. A global positioning system (GPS) may also be added to the PDA, to facilitate medical rescue in an emergency.

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	Mault at [0077] FIG. 2 shows a system embodiment, comprising portable computing device 30 having a display 32, data entry mechanism 34, and wireless transceiver 36; a wrist-mounted glucose sensor 38 having a strap 40; activity monitor 42 supported by the person's body using belt 44; insulin storage and dispensing device 46 comprising a subcutaneous needle 50 and delivery system 48 such as a pump. The portable computing device 30 is in linked to a communications network 52, allowing communication a remote computer system 54, which may be located at the person's home, doctor's office, or other remote location. A remote server system 56 is also accessible through the communications network 52, and can be used to store a database of physiological parameters, activity, and diet relating to the person, for medical, nutritional, or computer expert system analysis. The wrist mounted sensor 40 and activity monitor 42 can transmit data to the portable computing device 30 through a wireless method. The device 30 can be carried in a pocket of the person's clothes, or on a belt clip, or other convenient method. Mault at [0079] The PDA may also be in communication with a remote computer system, for example the Internet. Advice from a computer expert system, physician, web site, etc. may be displayed to the person as text, graphics, video, etc., on the PDA or other display device such as an interactive television. Mault at [0180] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or	Mault discloses wherein the measurement system is configured to use artificial intelligence in making decisions; wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set.

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classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Mault discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Mault discloses or renders obvious the measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Mault discloses or renders obvious the measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above; *see also* [11.a], [11.e]. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	

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15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Mault discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Mault discloses or renders obvious the measurement system of claim 15, wherein the first arc and the second arc are concentric. *See* claim 15 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mault discloses or renders obvious wearable device for use with a smart phone or tablet, the wearable device. *See* 11[a], 11[k]

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	Mault discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* above at claim 11[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Mault discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths. *See* 11[a], 11[b], 19[a]. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and

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	improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Mault discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the	Mault discloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue. *See* 11[d], 11[h], 11[i], 19[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Mault discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor sources. See 11[a], 11[b], 11[g], 19[a], 19[b], 19[d] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Mault discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. See 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at	Mault discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources.

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least one of the semiconductor sources;	*See* above at claim 11[a], 11[b], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Mault discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* above at claim 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Mault discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* 11[k], 19[pre] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link.	Mault discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, and store and display the processed output signal. *See* 11[k], 19[pre] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Mault discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claims 19, 13 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors	Mault discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.

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arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	*See* claims 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Mault discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claims 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D11

U.S. Pat. No. 10,874,304 in view of U.S. Patent Publication No. 2011/0082711 to Jeroen Poeze ("Poeze")

As described in detail below, Poeze (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D10 and D12-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. . This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Poeze. The cited portions of Poeze are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Poeze. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Poeze "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Poeze does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Poeze (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Poeze anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

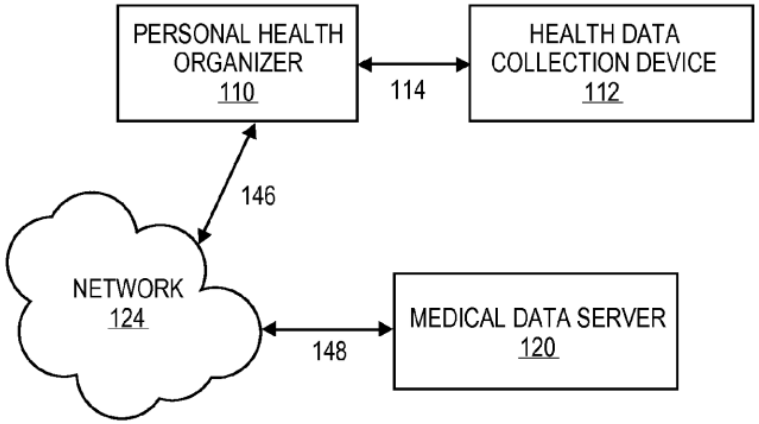
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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EXHIBIT D11

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Claim 11	
11[pre] A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Poeze discloses or renders obvious a measurement system. FIG. 1A shows a personal health organizer 110 as a device configured for analyzing data collected by a health data collection device 112. As shown in FIG. 1A, the personal health organizer 110 can be connected to the health data collection device 112 via a communications link 114. The communications link 114 can be a wired or wireless connection adapted to transfer data between the two devices. Examples of wired connections include USB, serial, and parallel and examples of wireless connections include Bluetooth®, Wi-Fi, WiMAX, Wireless USB, and ZIGBEE. In various embodiments, the health data collection device 112 is configured to collect physiological data from a patient invasively or non-invasively. The health data collection device 112 can be a glucometer, a pulse oximeter, monitor devices that measure total hemoglobin, SpO2, methemoglobin, carboxyhemoglobin, and the like. Example portable non-invasive monitoring devices are disclosed in co-pending U.S. patent application Ser. No. 12/534,827, filed Aug. 3, 2009, assigned to Masimo Labs of Irvine, Calif., the Assignee of the present application, the disclosure of which is incorporated herein by reference. Poeze at [0029]

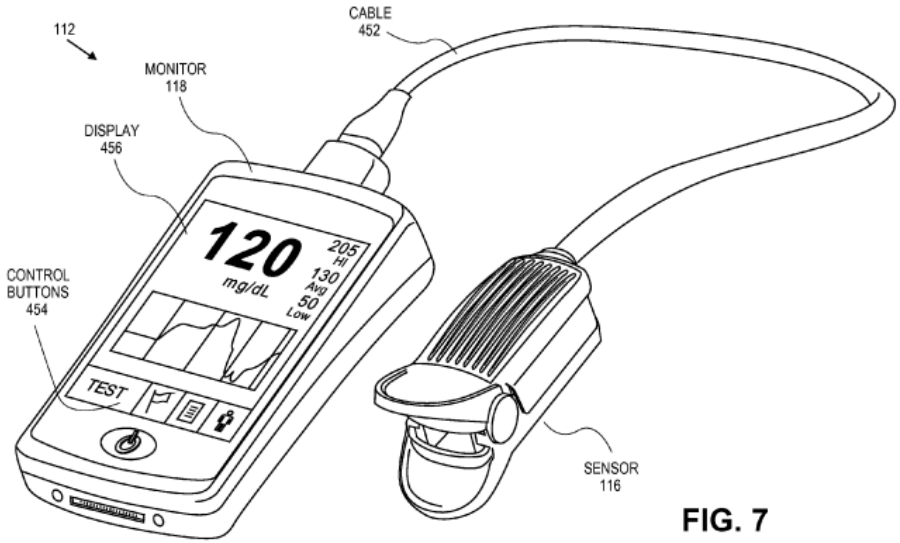
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	 FIG. 1A Poeze at Fig. 1A. In the embodiment depicted in FIG. 1B, the health data collection device 112 includes a finger clip sensor 116 connected to a monitor 118 via a cable. Moreover, the monitor 118 can advantageously includes electronic processing, signal processing, and data storage devices capable of receiving signal data from the sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Alternatively, in an embodiment, the personal health organizer 110 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the personal health organizer 110, and in that embodiment the personal health organizer 110 includes components and devices for processing the signal data from the sensor 116. Poeze at [0031] The monitor 118 can also include other components, such as a speaker, a power button, removable storage or memory (e.g., a flash card slot), an AC or DC power port, and one or more network interfaces, such as a universal serial bus (USB) interface, an Ethernet port, or a wireless port. These

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	interfaces and ports can be used by the monitor 118 in one embodiment to communicate with the sensor 116 via a communication link 104, which may include various types of communication protocols and links as described above with respect to the communication link 114. For example, the monitor 118 can include a display that can indicate a measurement for glucose, for example, in mg/dL. Other analytes and forms of display can also appear on the monitor 118. Poeze at [0032] In addition, although a single sensor with a single monitor 118 is shown, different combinations of sensors and device pairings can be implemented. For example, multiple sensors can be provided for a plurality of differing patient types or measurement sites or even patient fingers. The sensor 116 can also connect to the monitor 118 wirelessly. Alternatively, the sensor 116 and the monitor 118 can be integrated into a single unit. A skilled artisan would appreciate that many other monitoring device configurations can be used as well. Poeze at [0033] FIG. 7 illustrates an example of a health data collection device 112. In the depicted embodiment, the monitoring device 118 includes a finger clip sensor 116 connected to a monitor 118 via a cable 452. In the embodiment shown, the monitor 118 includes a display 456, control buttons 454 and a power button. Moreover, the monitor 118 can advantageously include electronic processing, signal processing, and data storage devices capable of receiving signal data from said sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Poeze at [0093]

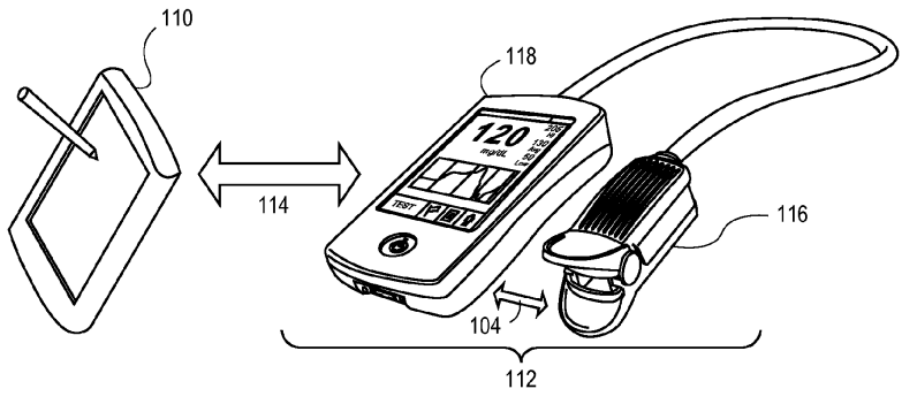
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	 FIG. 7 Poeze at fig. 7. The monitor 118 can also include other components, such as a speaker, power button, removable storage or memory (e.g., a flash card slot), an AC or DC power port, and one or more network interfaces, such as a universal serial bus interface or an Ethernet port. For example, the monitor 118 can include a display 456 that can indicate a measurement for glucose, for example, in mg/dL. Other analytes and forms of display can also appear on the monitor 118. Poeze at [0096] In addition, although a single sensor 116 with a single monitor 118 is shown, different combinations of sensors and device pairings can be implemented. For example, multiple sensors can be provided for a plurality of differing patient types or measurement sites or even patient fingers. Poeze at [0097]. The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described

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	primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a] a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Poeze discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths. In other embodiments, the personal health organizer includes an accelerometer that detects user motion and the motion can assist in the collection of and/or display of medical/reading data. For example, the accelerometer can detect a user's intent to use the device via touch/motion and automatically start the collection of data when the user places his or her finger into a sensor associated with a health collection data device. In another example, the personal health organizer can begin health data collection once the user places his or her finger into a sensor associated with a health collection data device and/or provides a gesture via a touch-screen input associated with the personal health organizer. In yet another example, the personal health organizer begins the data collection when the user places a finger into the sensor. The LEDs and photo diodes in the sensor can detect the presence of the finger and initiate data collection. The presence of a finger can be determined, for example, by determining when there is a significant reduction in detected light. Such a reduction in detected light can indicate the presence of a finger and start the data collection process. Poeze at [0013] FIG. 1A shows a personal health organizer 110 as a device configured for analyzing data collected by a health data collection device 112. As shown in FIG. 1A, the personal health organizer 110 can be

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	connected to the health data collection device 112 via a communications link 114. The communications link 114 can be a wired or wireless connection adapted to transfer data between the two devices. Examples of wired connections include USB, serial, and parallel and examples of wireless connections include Bluetooth®, Wi-Fi, WiMAX, Wireless USB, and ZIGBEE. In various embodiments, the health data collection device 112 is configured to collect physiological data from a patient invasively or non-invasively. The health data collection device 112 can be a glucometer, a pulse oximeter, monitor devices that measure total hemoglobin, SpO2, methemoglobin, carboxyhemoglobin, and the like. Example portable non-invasive monitoring devices are disclosed in co-pending U.S. patent application Ser. No. 12/534,827, filed Aug. 3, 2009, assigned to Masimo Labs of Irvine, Calif., the Assignee of the present application, the disclosure of which is incorporated herein by reference. Poeze at [0029] In the embodiment depicted in FIG. 1B, the health data collection device 112 includes a finger clip sensor 116 connected to a monitor 118 via a cable. Moreover, the monitor 118 can advantageously includes electronic processing, signal processing, and data storage devices capable of receiving signal data from the sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Alternatively, in an embodiment, the personal health organizer 110 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the personal health organizer 110, and in that embodiment the personal health organizer 110 includes components and devices for processing the signal data from the sensor 116. Poeze at [0031]

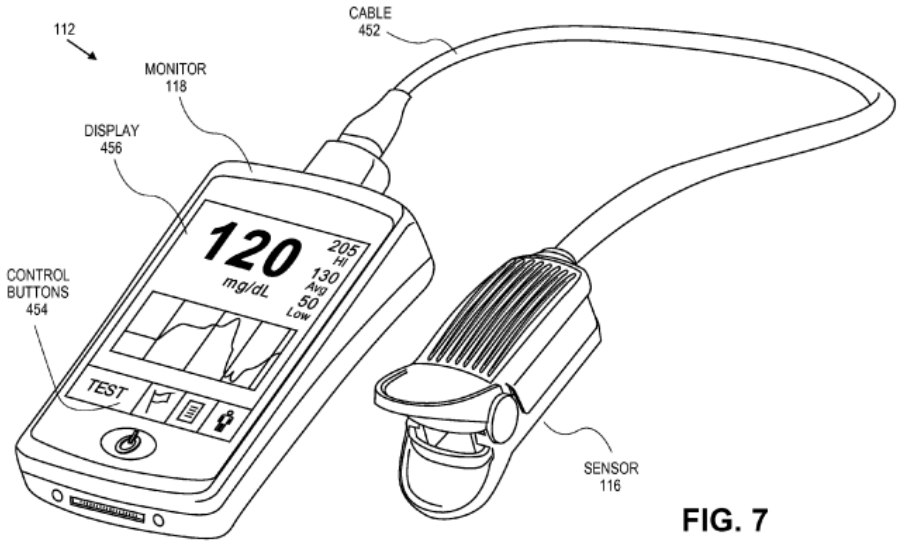
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	 **FIG. 1B** Poeze at Fig.1B In addition, although a single sensor with a single monitor 118 is shown, different combinations of sensors and device pairings can be implemented. For example, multiple sensors can be provided for a plurality of differing patient types or measurement sites or even patient fingers. The sensor 116 can also connect to the monitor 118 wirelessly. Alternatively, the sensor 116 and the monitor 118 can be integrated into a single unit. A skilled artisan would appreciate that many other monitoring device configurations can be used as well. Poeze at [0033] In another embodiment, the personal health organizer is adapted to connect to a sleep sensor, which includes a finger or a toe adhesive sensor that records data to a solid state drive. The recorded data can then be downloaded to the personal health organizer device the next morning to obtain hours of reading data recorded while the user was asleep. The connection to the sleep sensor can be wireless, e.g., the personal health organizer device can near field connect (NFC) to the sensor. Optionally, the sleep sensor can include a component that sends reading data in real time to the personal health organizer device (e.g. via Bluetooth® 2.1 +EDR (300′ range)), and instructs the personal health organizer to contact medical personnel or an emergency contact if the reading data indicates a urgent medical need.

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	Poeze at [0085] In another embodiment, if the device is used by a new user, based on the new user's reading (e.g. blood glucose reading), the device security module 342 can recognize that the user has changed. The device can then prompt the new user to enter a password. The device security module 342 can also utilize biometric identification, for example, through the built-in camera 214. The device security module 342 can recognize the face and expressions of the user from the camera. Another embodiment includes an additional rear sub CCD or CMOS camera placed behind an LCD or OLED screen so the user could be prompted for finger print or palm identification. In addition, a CCD or CMOS camera can be embedded in the sensor to take picture of the user's finger print. In addition to or in place of external biometric identification, a special near infrared emitter detector can absorb the unique vein pattern of the finger. The device security module 342 can also utilize the CCD or CMOS camera to distinguish among patients when the device is shared among multiple patients (e.g. in a hospital setting for where a healthcare personnel is using the device for multiple patients). Once a patient's finger print is recognized, the device automatically brings up the patient's file. Poeze at [0092]. FIG. 7 illustrates an example of a health data collection device 112. In the depicted embodiment, the monitoring device 118 includes a finger clip sensor 116 connected to a monitor 118 via a cable 452. In the embodiment shown, the monitor 118 includes a display 456, control buttons 454 and a power button. Moreover, the monitor 118 can advantageously include electronic processing, signal processing, and data storage devices capable of receiving signal data from said sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Poeze at [0093].

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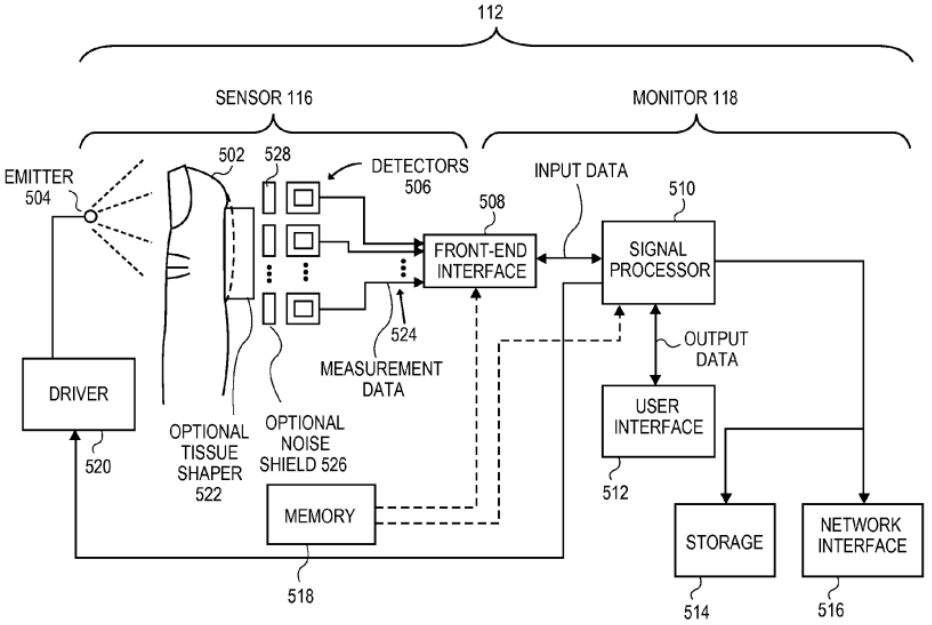
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	 FIG. 7 Poeze at fig. 7. In addition, although a single sensor 116 with a single monitor 118 is shown, different combinations of sensors and device pairings can be implemented. For example, multiple sensors can be provided for a plurality of differing patient types or measurement sites or even patient fingers. Poeze at [0097]. The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101]. In the depicted embodiment shown in FIG. 8, the sensor 116 includes an emitter 504, a tissue shaper 522, a set of detectors 506, and a front-end interface 508. The emitter 504 can serve as the source of optical

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	radiation transmitted towards measurement site 102. As will be described in further detail below, the emitter 504 can include one or more sources of optical radiation, such as LEDs, laser diodes, incandescent bulbs with appropriate frequency-selective filters, combinations of the same, or the like. In an embodiment, the emitter 504 includes sets of optical sources that are capable of emitting visible and near-infrared optical radiation. Poeze at [0106]. In some embodiments, the emitter 504 is used as a point optical source, and thus, the one or more optical sources of the emitter 504 can be located within a close distance to each other, such as within about a 2 mm to about 4 mm. The emitters 504 can be arranged in an array, such as is described in U.S. Publication No. 2006/0211924, filed Sep. 21, 2006, titled “Multiple Wavelength Sensor Emitters,” the disclosure of which is hereby incorporated by reference in its entirety. In particular, the emitters 504 can be arranged at least in part as described in paragraphs [0061] through [0068] of the aforementioned publication, which paragraphs are hereby incorporated specifically by reference. Other relative spatial relationships can be used to arrange the emitters 504. Poeze at [0107] For analytes like glucose, currently available non-invasive techniques often attempt to employ light near the water absorbance minima at or about 1600 nm. Typically, these devices and methods employ a single wavelength or single band of wavelengths at or about 1600 nm. However, to date, these techniques have been unable to adequately consistently measure analytes like glucose based on spectroscopy. Poeze at [0108] In contrast, the emitter 504 of the data collection device 112 can emit, in certain embodiments, combinations of optical radiation in various bands of interest. For example, in some embodiments, for analytes like glucose, the emitter 504 can emit optical radiation at three (3) or more wavelengths between about 1600 nm to about 1700 nm. In particular, the emitter 504 can emit optical radiation at or about 1610 nm, about 1640 nm, and about 1665 nm. In some circumstances, the use of three wavelengths within about 1600 nm to about 1700 nm enable sufficient SNRs of about 100 dB, which can result in a measurement accuracy of about 20 mg/dL or better for analytes like glucose.

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	Poeze at [0109] In other embodiments, the emitter 504 can use two (2) wavelengths within about 1600 nm to about 1700 nm to advantageously enable SNRs of about 85 dB, which can result in a measurement accuracy of about 25-30 mg/dL or better for analytes like glucose. Furthermore, in some embodiments, the emitter 504 can emit light at wavelengths above about 1670 nm. Measurements at these wavelengths can be advantageously used to compensate or confirm the contribution of protein, water, and other non-hemoglobin species exhibited in measurements for analytes like glucose conducted between about 1600 nm and about 1700 nm. Of course, other wavelengths and combinations of wavelengths can be used to measure analytes and/or to distinguish other types of tissue, fluids, tissue properties, fluid properties, combinations of the same or the like. Poeze at [0110] For example, the emitter 504 can emit optical radiation across other spectra for other analytes. In particular, the emitter 504 can employ light wavelengths to measure various blood analytes or percentages (e.g., saturation) thereof. For example, in an embodiment, the emitter 504 can emit optical radiation in the form of pulses at wavelengths about 905 nm, about 1050 nm, about 1200 nm, about 1300 nm, about 1330 nm, about 1610 nm, about 1640 nm, and about 1665 nm. In another embodiment, the emitter 504 can emit optical radiation ranging from about 860 nm to about 950 nm, about 950 nm to about 1100 nm, about 1100 nm to about 1270 nm, about 1250 nm to about 1350 nm, about 1300 nm to about 1360 nm, and about 1590 nm to about 1700 nm. Of course, the emitter 504 can transmit any of a variety of wavelengths of visible or near-infrared optical radiation. Poeze at [0111]

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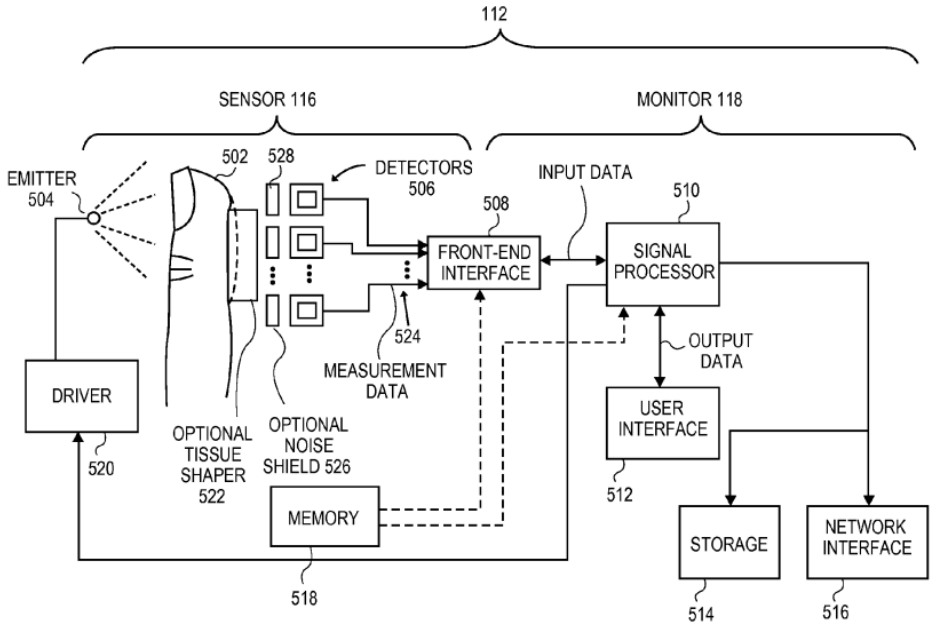
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	 **FIG. 8** Poeze at Fig.8 As briefly described above, the emitter 504 can include sets of light-emitting diodes (LEDs) as its optical source. The emitter 504 can use one or more top-emitting LEDs. In particular, in some embodiments, the emitter 504 can include top-emitting LEDs emitting light at about 850 nm to 1350 nm. Poeze at [0113] The emitter 504 can also use super luminescent LEDs (SLEDs) or side-emitting LEDs. In some embodiments, the emitter 504 can employ SLEDs or side-emitting LEDs to emit optical radiation at about 1600 nm to about 1700 nm. Emitter 504 can use SLEDs or side-emitting LEDs to transmit near infrared optical radiation because these types of sources can transmit at high power or relatively high power, e.g., about 40 mW to about 100 mW. This higher power capability can be useful to compensate or overcome the greater attenuation of these wavelengths of light in tissue and water. For example, the

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	higher power emission can effectively compensate and/or normalize the absorption signal for light in the mentioned wavelengths to be similar in amplitude and/or effect as other wavelengths that can be detected by one or more photodetectors after absorption. However, the embodiments of the present disclosure do not necessarily require the use of high power optical sources. For example, some embodiments may be configured to measure analytes, such as total hemoglobin (tHb), oxygen saturation (SpO2), carboxyhemoglobin, methemoglobin, etc., without the use of high power optical sources like side emitting LEDs. Instead, such embodiments may employ other types of optical sources, such as top emitting LEDs. Alternatively, the emitter 504 can use other types of sources of optical radiation, such as a laser diode, to emit near-infrared light into the measurement site 502. Poeze at [0114] In addition, in some embodiments, in order to assist in achieving a comparative balance of desired power output between the LEDs, some of the LEDs in the emitter 504 can have a filter or covering that reduces and/or cleans the optical radiation from particular LEDs or groups of LEDs. For example, since some wavelengths of light can penetrate through tissue relatively well, LEDs, such as some or all of the top-emitting LEDs can use a filter or covering, such as a cap or painted dye. This can be useful in allowing the emitter 504 to use LEDs with a higher output and/or to equalize intensity of LEDs. Poeze at [0115] The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver

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	520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million. Poeze at [0117] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b] the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Poeze discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB) or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose. Poeze at [0100]. The embodiment of the data collection device 112 shown also includes an optional noise shield 526. In an embodiment, the noise shield 526 can be advantageously adapted to reduce electromagnetic noise while increasing the transmittance of light from the measurement site 502 to one or more detectors 506 (described below). For example, the noise shield 526 can advantageously include a conductive coated glass or metal grid electrically communicating with one or more other shields of the sensor 116 or electrically grounded. In an embodiment where the noise shield 526 includes conductive coated glass, the coating can advantageously include indium tin oxide. In an embodiment, the indium tin oxide includes a surface resistivity ranging from approximately 30 ohms per square inch to about 500 ohms per square inch. In an embodiment, the resistivity is approximately 30, 200, or 500 ohms per square inch.

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	As would be understood by a person of skill in the art from the present disclosure, other resistivities can also be used which are less than about 30 ohms or more than about 500 ohms. Other conductive materials transparent or substantially transparent to light can be used instead. Poeze at [0103]  **FIG. 8** Poeze at Fig.8 In addition, in some embodiments, in order to assist in achieving a comparative balance of desired power output between the LEDs, some of the LEDs in the emitter 504 can have a filter or covering that reduces and/or cleans the optical radiation from particular LEDs or groups of LEDs. For example, since some wavelengths of light can penetrate through tissue relatively well, LEDs, such as some or all of the top-emitting LEDs can use a filter or covering, such as a cap or painted dye. This can be useful in allowing the emitter 504 to use LEDs with a higher output and/or to equalize intensity of LEDs.

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	Poeze at [0115] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

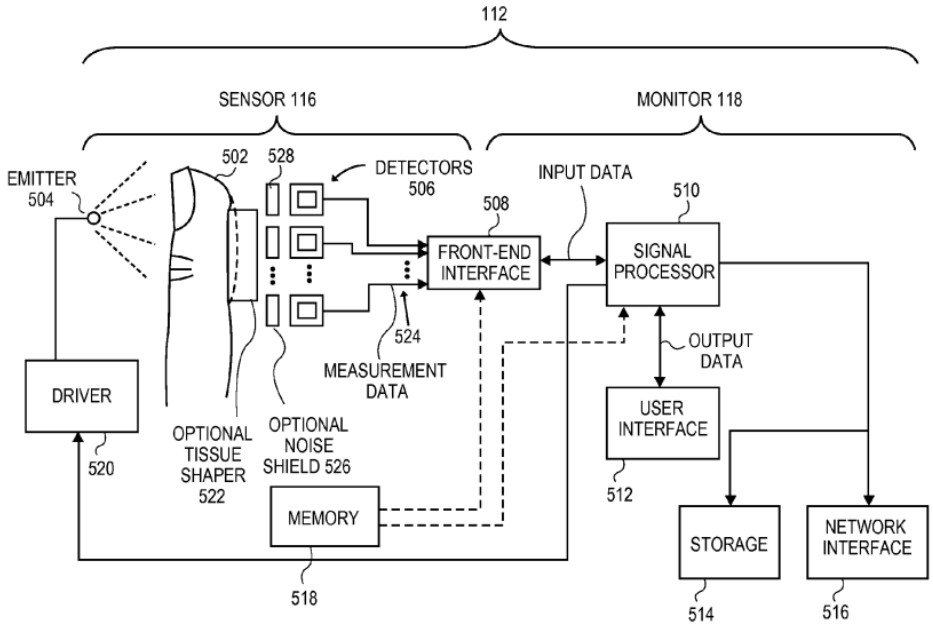
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11[c] the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Poeze discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. In other embodiments, the personal health organizer includes an accelerometer that detects user motion and the motion can assist in the collection of and/or display of medical/reading data. For example, the accelerometer can detect a user's intent to use the device via touch/motion and automatically start the collection of data when the user places his or her finger into a sensor associated with a health collection data device. In another example, the personal health organizer can begin health data collection once the user places his or her finger into a sensor associated with a health collection data device and/or provides a gesture via a touch-screen input associated with the personal health organizer. In yet another example, the personal health organizer begins the data collection when the user places a finger into the sensor. The LEDs and photo diodes in the sensor can detect the presence of the finger and initiate data collection. The presence of a finger can be determined, for example, by determining when there is a significant reduction in detected light. Such a reduction in detected light can indicate the presence of a finger and start the data collection process. Poeze at [0013]. The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101]. In the depicted embodiment, the device 112 includes an optional tissue thickness adjuster or tissue shaper 522, which can include one or more protrusions, bumps, lenses, or other suitable tissue-shaping mechanisms. In certain embodiments, the tissue shaper 522 is a flat or substantially flat surface that can be positioned proximate the measurement site 502 and that can apply sufficient pressure to cause the tissue of the measurement site 502 to be flat or substantially flat. In other embodiments, the tissue shaper 522 is a convex or substantially convex surface with respect to the measurement site 502. Many other

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	configurations of the tissue shaper 522 are possible. Advantageously, in certain embodiments, the tissue shaper 522 reduces thickness of the measurement site 502 while preventing or reducing occlusion at the measurement site 502. Reducing thickness of the site can advantageously reduce the amount of attenuation of the light because there is less tissue through which the light must travel. Shaping the tissue in to a convex (or alternatively concave) surface can also provide more surface area from which light can be detected. Poeze at [0102]. In the depicted embodiment shown in FIG. 8, the sensor 116 includes an emitter 504, a tissue shaper 522, a set of detectors 506, and a front-end interface 508. The emitter 504 can serve as the source of optical radiation transmitted towards measurement site 102. As will be described in further detail below, the emitter 504 can include one or more sources of optical radiation, such as LEDs, laser diodes, incandescent bulbs with appropriate frequency-selective filters, combinations of the same, or the like. In an embodiment, the emitter 504 includes sets of optical sources that are capable of emitting visible and near-infrared optical radiation. Poeze at [0106]

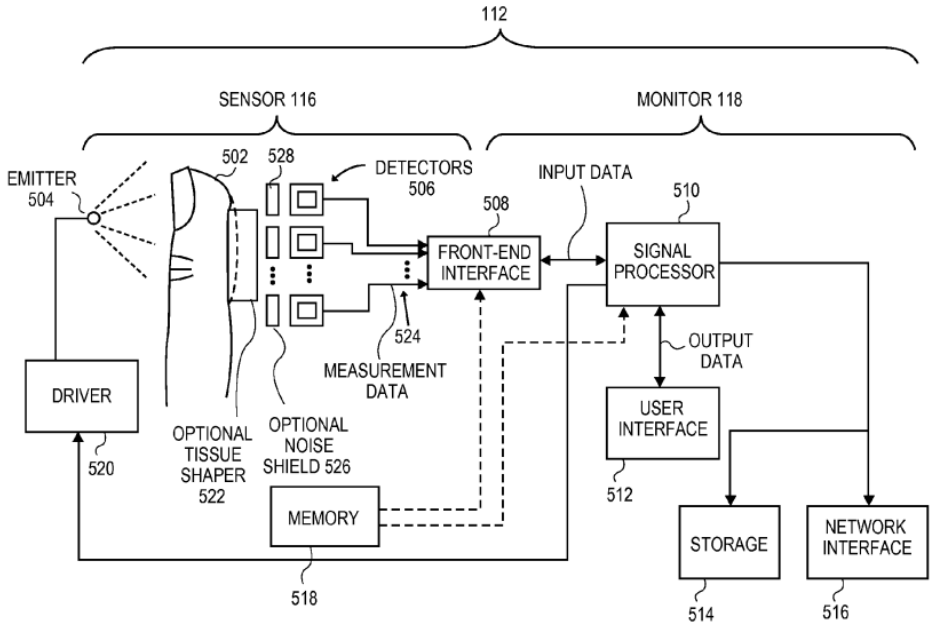
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	 **FIG. 8** Poeze at Fig.8 In addition, in some embodiments, in order to assist in achieving a comparative balance of desired power output between the LEDs, some of the LEDs in the emitter 504 can have a filter or covering that reduces and/or cleans the optical radiation from particular LEDs or groups of LEDs. For example, since some wavelengths of light can penetrate through tissue relatively well, LEDs, such as some or all of the top-emitting LEDs can use a filter or covering, such as a cap or painted dye. This can be useful in allowing the emitter 504 to use LEDs with a higher output and/or to equalize intensity of LEDs. Poeze at [0115] While certain embodiments of the inventions disclosed herein have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions disclosed herein. Indeed, the novel methods and systems described herein can be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the methods and

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	systems described herein can be made without departing from the spirit of the inventions disclosed herein. The claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of certain of the inventions disclosed herein. Poeze at [0133] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d] the wearable measurement device further comprising a receiver configured to:	Poeze discloses or renders obvious the wearable measurement device further comprising a receiver. In the depicted embodiment shown in FIG. 8, the sensor 116 includes an emitter 504, a tissue shaper 522, a set of detectors 506, and a front-end interface 508. The emitter 504 can serve as the source of optical radiation transmitted towards measurement site 102. As will be described in further detail below, the emitter 504 can include one or more sources of optical radiation, such as LEDs, laser diodes, incandescent bulbs with appropriate frequency-selective filters, combinations of the same, or the like. In an embodiment, the emitter 504 includes sets of optical sources that are capable of emitting visible and near-infrared optical radiation. Poeze at [0106] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118]

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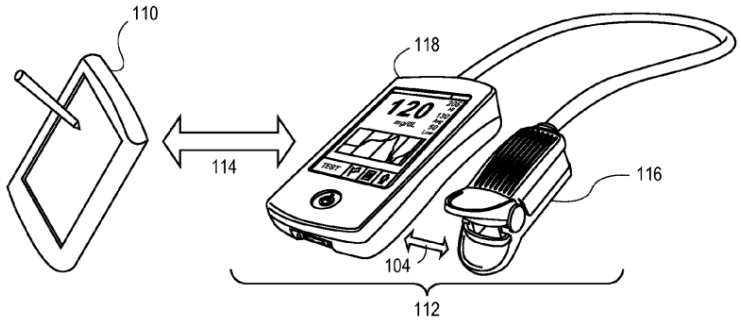
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	 **FIG. 8** Poeze at Fig.8 In addition, the detectors 506 can be arranged with a spatial configuration to provide a variation of path lengths among at least some of the detectors 506. That is, some of the detectors 506 can have the substantially, or from the perspective of the processing algorithm, effectively, the same path length from the emitter 504. However, according to an embodiment, at least some of the detectors 506 can have a different path length from the emitter 504 relative to other of the detectors 506. Variations in path lengths can be helpful in allowing the use of a bulk signal stream from the detectors 506. In some embodiments, the detectors 506 may employ a linear spacing, a logarithmic spacing, or a two or three dimensional matrix of spacing, or any other spacing scheme in order to provide an appropriate variation in path lengths. Poeze at [0119]

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	The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] The front-end interface 508 can be coupled to the detectors 506 and to the signal processor 510 using a bus, wire, electrical or optical cable, flex circuit, or some other form of signal connection. The front-end interface 508 can also be at least partially integrated with various components, such as the detectors 506. For example, the front-end interface 508 can include one or more integrated circuits that are on the same circuit board as the detectors 506. Other configurations can also be used. Poeze at [0121] The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122] The ADC or ADCs can provide one or more outputs into multiple channels of digital information for processing by the signal processor 510 of the monitor 118. Each channel can correspond to a signal output from a detector 506.

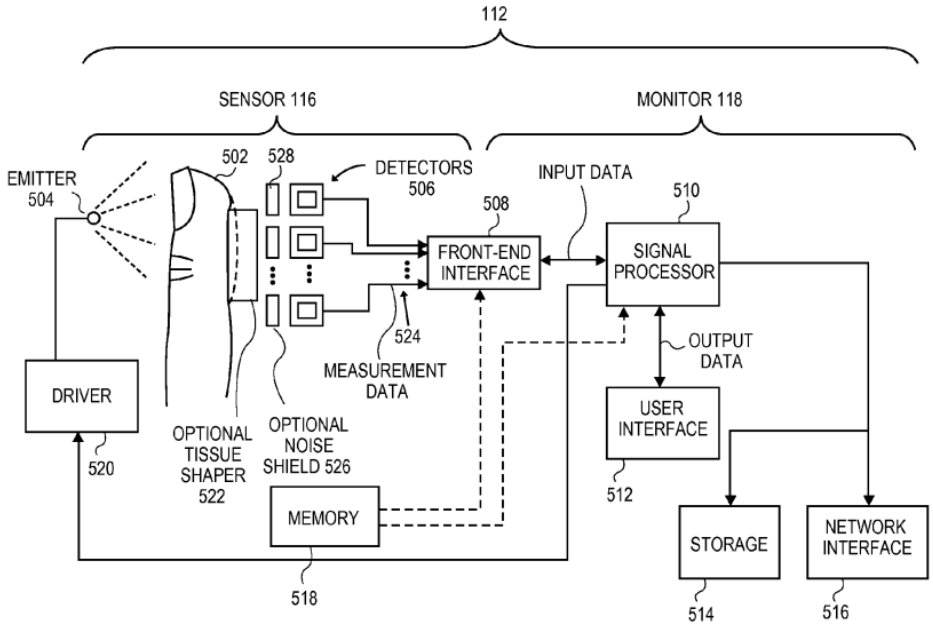
’304 Patent	Poeze
	Poeze at [0123] In some embodiments, a programmable gain amplifier (PGA) can be used in combination with a transimpedance-based front-end interface 508. For example, the output of a transimpedance-based front-end interface 508 can be output to a PGA that is coupled with an ADC in the monitor 118. A PGA can be useful in order to provide another level of amplification and control of the stream of signals from the detectors 506. Alternatively, the PGA and ADC components can be integrated with the transimpedance-based front-end interface 508 in the sensor 116. Poeze at [0124] In another embodiment, the front-end interface 508 can be implemented using switched-capacitor circuits. A switched-capacitor-based front-end interface 508 can be useful for, in certain embodiments, its resistor-free design and analog averaging properties. In addition, a switched-capacitor-based front-end interface 508 can be useful because it can provide a digital signal to the signal processor 510 in the monitor 118. Poeze at [0125] As shown in FIG. 8, the monitor 118 can include the signal processor 510 and a user interface, such as a display 512. The monitor 109 can also include optional outputs alone or in combination with the display 512, such as a storage device 514 and a network interface 516. In an embodiment, the signal processor 510 includes processing logic that determines measurements for desired analytes, such as glucose, based on the signals received from the detectors 506. The signal processor 510 can be implemented using one or more microprocessors or subprocessors (e.g., cores), digital signal processors, application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), combinations of the same, and the like. Poeze at [0126] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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11[e] receive and process at least a portion of the analysis output beam reflected or transmitted from the sample.	Poeze discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. In the embodiment depicted in FIG. 1B, the health data collection device 112 includes a finger clip sensor 116 connected to a monitor 118 via a cable. Moreover, the monitor 118 can advantageously includes electronic processing, signal processing, and data storage devices capable of receiving signal data from the sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Alternatively, in an embodiment, the personal health organizer 110 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the personal health organizer 110, and in that embodiment the personal health organizer 110 includes components and devices for processing the signal data from the sensor 116. Poeze at [0031]  **FIG. 1B** Poeze at Fig. 1b

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	The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118]

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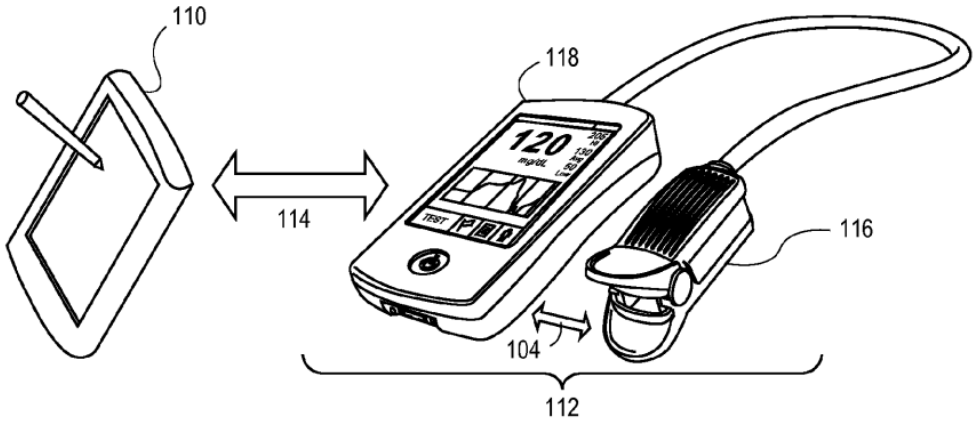
’304 Patent	Poeze
	 **FIG. 8** Poeze at Fig.8 In addition, the detectors 506 can be arranged with a spatial configuration to provide a variation of path lengths among at least some of the detectors 506. That is, some of the detectors 506 can have the substantially, or from the perspective of the processing algorithm, effectively, the same path length from the emitter 504. However, according to an embodiment, at least some of the detectors 506 can have a different path length from the emitter 504 relative to other of the detectors 506. Variations in path lengths can be helpful in allowing the use of a bulk signal stream from the detectors 506. In some embodiments, the detectors 506 may employ a linear spacing, a logarithmic spacing, or a two or three dimensional matrix of spacing, or any other spacing scheme in order to provide an appropriate variation in path lengths. Poeze at [0119]

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	The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] The front-end interface 508 can be coupled to the detectors 506 and to the signal processor 510 using a bus, wire, electrical or optical cable, flex circuit, or some other form of signal connection. The front-end interface 508 can also be at least partially integrated with various components, such as the detectors 506. For example, the front-end interface 508 can include one or more integrated circuits that are on the same circuit board as the detectors 506. Other configurations can also be used. Poeze at [0121] The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122] The ADC or ADCs can provide one or more outputs into multiple channels of digital information for processing by the signal processor 510 of the monitor 118. Each channel can correspond to a signal output from a detector 506.

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	Poeze at [0123] In some embodiments, a programmable gain amplifier (PGA) can be used in combination with a transimpedance-based front-end interface 508. For example, the output of a transimpedance-based front-end interface 508 can be output to a PGA that is coupled with an ADC in the monitor 118. A PGA can be useful in order to provide another level of amplification and control of the stream of signals from the detectors 506. Alternatively, the PGA and ADC components can be integrated with the transimpedance-based front-end interface 508 in the sensor 116. Poeze at [0124] In another embodiment, the front-end interface 508 can be implemented using switched-capacitor circuits. A switched-capacitor-based front-end interface 508 can be useful for, in certain embodiments, its resistor-free design and analog averaging properties. In addition, a switched-capacitor-based front-end interface 508 can be useful because it can provide a digital signal to the signal processor 510 in the monitor 118. Poeze at [0125] As shown in FIG. 8, the monitor 118 can include the signal processor 510 and a user interface, such as a display 512. The monitor 109 can also include optional outputs alone or in combination with the display 512, such as a storage device 514 and a network interface 516. In an embodiment, the signal processor 510 includes processing logic that determines measurements for desired analytes, such as glucose, based on the signals received from the detectors 506. The signal processor 510 can be implemented using one or more microprocessors or subprocessors (e.g., cores), digital signal processors, application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), combinations of the same, and the like. Poeze at [0126] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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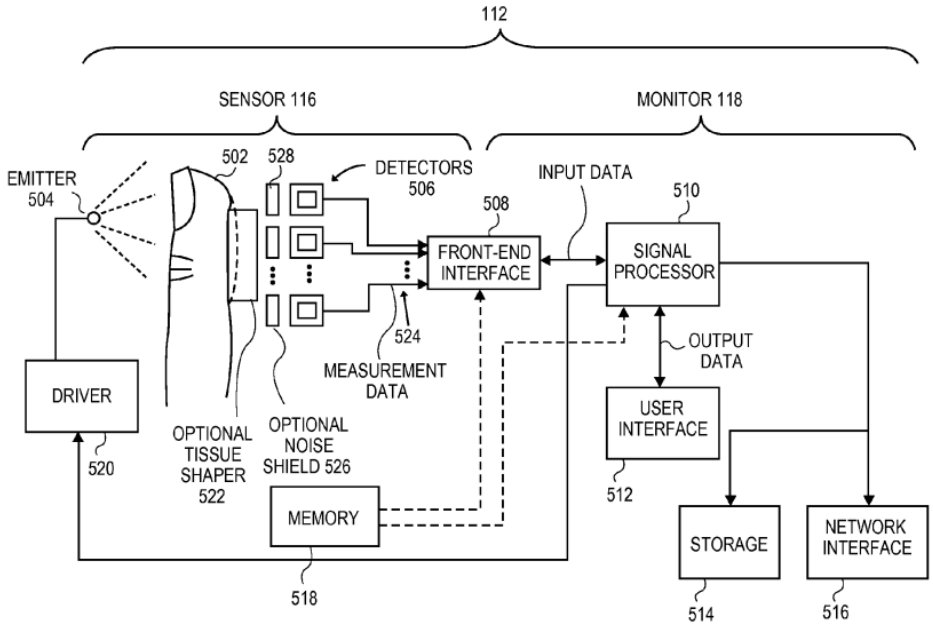
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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f] generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Poeze discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. In the embodiment depicted in FIG. 1B, the health data collection device 112 includes a finger clip sensor 116 connected to a monitor 118 via a cable. Moreover, the monitor 118 can advantageously includes electronic processing, signal processing, and data storage devices capable of receiving signal data from the sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Alternatively, in an embodiment, the personal health organizer 110 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the personal health organizer 110, and in that embodiment the personal health organizer 110 includes components and devices for processing the signal data from the sensor 116. Poeze at [0031]

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	 **FIG. 1B** Poeze at fig. 1b. As shown in FIG. 2B, the general computing device 126 can be coupled with the health data collection device 112, with the monitor 118 and sensor 116 as described above. In the embodiments shown in FIGS. 1A, 1B, 2A, and 2B, the communication and/or I/O interfaces of the health data collection device 112 can be used to connect to personal health organizer 110 or 126. For example, the USB interface could be used to connect the monitor 118 to a USB port of the personal health organizer 110 or 126. As another example, the wireless port of the health data collection device 112 could be used to communicate with the personal health organizer via a wireless link, such as an RF or infrared link or a Bluetooth® link. A skilled artisan will appreciate that a variety of other configurations and communication mechanisms are possible. For example, in an embodiment, general purpose computer device 126 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the general purpose computer device 126, and in that embodiment the general purpose computer device 126 includes components and devices for processing the signal data from the sensor 116. In another embodiment, the sensor 116 can be connected wirelessly to the general purpose computer device 126 through one or more known wireless connection protocols such as Bluetooth®. A skilled artisan will also appreciate that connecting the monitor 118 to the personal health organizer can allow the personal health organizer to collect, store, or analyze the output measurement values produced by the monitor 118.

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	Poeze at [0035] As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the following components: one or more computer processor(s) 202, a storage 204, a display/touch panel 206, and an interface 208. One or more of these components can be connected together via a system bus 210. In an embodiment, the storage 204 includes (1) data storage such as a hard disk and/or removable media such as a flash drive, and/or (2) memory storage such as RAM or ROM. The processor(s) 202 can process signals received from a sensor such as the sensor 116 shown in FIGS. 1B, 2B, and 3B and derive physiological readings such as blood glucose level or other parameters from the signals. The storage 204 can include instructions or data for performing one or more methods disclosed herein. In one or more embodiments, the storage 204 includes a media card reader interface that accepts a media card such as an SD card, a microSD card, a memory stick, a CF card and the like. The portable media card can be used to store patient information and enable the personal health organizer device to be shared, with the settings and data for the individual user stored in the user's media card. The personal health organizer can also include a biometric identification module (such as a vein pattern or finger print scanner) 246 to distinguish one user from another or provide security for information stored. Poeze at [0040]. FIGS. 6A and 6B show methods for integrating medical data records in accordance with embodiments disclosed herein. At block 352, in an embodiment, a signal indicative of the patient physiological reading is received and/or detected at a sensor of the personal health organizer (or an associated health data collection device). At block 354, the personal health organizer (or an associated health data collection device) can process the signal to derive or calculate reading data (e.g. derive blood glucose level based on signal received). At the block 360, the reading data can be stored locally (e.g. in the storage 204) along with other medical data of the patient user. At block 362, the personal health organizer can use the reading data to customize local content at the personal health organizer, including games and educational materials. At block 364, the personal health organizer can use the reading data to generate health reminders and/or recommendations that are personalized for the patient user. Poeze at [0093].

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	The emitter 504 can also use super luminescent LEDs (SLEDs) or side-emitting LEDs. In some embodiments, the emitter 504 can employ SLEDs or side-emitting LEDs to emit optical radiation at about 1600 nm to about 1700 nm. Emitter 504 can use SLEDs or side-emitting LEDs to transmit near infrared optical radiation because these types of sources can transmit at high power or relatively high power, e.g., about 40 mW to about 100 mW. This higher power capability can be useful to compensate or overcome the greater attenuation of these wavelengths of light in tissue and water. For example, the higher power emission can effectively compensate and/or normalize the absorption signal for light in the mentioned wavelengths to be similar in amplitude and/or effect as other wavelengths that can be detected by one or more photodetectors after absorption. However, the embodiments of the present disclosure do not necessarily require the use of high power optical sources. For example, some embodiments may be configured to measure analytes, such as total hemoglobin (tHb), oxygen saturation (SpO2), carboxyhemoglobin, methemoglobin, etc., without the use of high power optical sources like side emitting LEDs. Instead, such embodiments may employ other types of optical sources, such as top emitting LEDs. Alternatively, the emitter 504 can use other types of sources of optical radiation, such as a laser diode, to emit near-infrared light into the measurement site 502. Poeze at [0114]. The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118]

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	 **FIG. 8** Poeze at Fig. 8 In addition, the detectors 506 can be arranged with a spatial configuration to provide a variation of path lengths among at least some of the detectors 506. That is, some of the detectors 506 can have the substantially, or from the perspective of the processing algorithm, effectively, the same path length from the emitter 504. However, according to an embodiment, at least some of the detectors 506 can have a different path length from the emitter 504 relative to other of the detectors 506. Variations in path lengths can be helpful in allowing the use of a bulk signal stream from the detectors 506. In some embodiments, the detectors 506 may employ a linear spacing, a logarithmic spacing, or a two or three dimensional matrix of spacing, or any other spacing scheme in order to provide an appropriate variation in path lengths. Poeze at [0119]

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	The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] The front-end interface 508 can be coupled to the detectors 506 and to the signal processor 510 using a bus, wire, electrical or optical cable, flex circuit, or some other form of signal connection. The front-end interface 508 can also be at least partially integrated with various components, such as the detectors 506. For example, the front-end interface 508 can include one or more integrated circuits that are on the same circuit board as the detectors 506. Other configurations can also be used. Poeze at [0121] The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122] The ADC or ADCs can provide one or more outputs into multiple channels of digital information for processing by the signal processor 510 of the monitor 118. Each channel can correspond to a signal output from a detector 506.

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	Poeze at [0123] In some embodiments, a programmable gain amplifier (PGA) can be used in combination with a transimpedance-based front-end interface 508. For example, the output of a transimpedance-based front-end interface 508 can be output to a PGA that is coupled with an ADC in the monitor 118. A PGA can be useful in order to provide another level of amplification and control of the stream of signals from the detectors 506. Alternatively, the PGA and ADC components can be integrated with the transimpedance-based front-end interface 508 in the sensor 116. Poeze at [0124] In another embodiment, the front-end interface 508 can be implemented using switched-capacitor circuits. A switched-capacitor-based front-end interface 508 can be useful for, in certain embodiments, its resistor-free design and analog averaging properties. In addition, a switched-capacitor-based front-end interface 508 can be useful because it can provide a digital signal to the signal processor 510 in the monitor 118. Poeze at [0125] As shown in FIG. 8, the monitor 118 can include the signal processor 510 and a user interface, such as a display 512. The monitor 109 can also include optional outputs alone or in combination with the display 512, such as a storage device 514 and a network interface 516. In an embodiment, the signal processor 510 includes processing logic that determines measurements for desired analytes, such as glucose, based on the signals received from the detectors 506. The signal processor 510 can be implemented using one or more microprocessors or subprocessors (e.g., cores), digital signal processors, application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), combinations of the same, and the like. Poeze at [0126] The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation

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	pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127] The user interface 112 can provide an output, e.g., on a display, for presentation to a user of the data collection device 112. The user interface 112 can be implemented as a touch-screen display, an LCD display, an organic LED display, or the like. In addition, the user interface 112 can be manipulated to allow for measurement on the non-dominant side of patient. For example, the user interface 112 can include a flip screen, a screen that can be moved from one side to another on the monitor 118, or can include an ability to reorient its display indicia responsive to user input or device orientation. In alternative embodiments, the data collection device 112 can be provided without a user interface 112 and can simply provide an output signal to a separate display or system. Poeze at [0128] A storage device 514 and a network interface 516 represent other optional output connections that can be included in the monitor 118. The storage device 514 can include any computer-readable medium, such as a memory device, hard disk storage, EEPROM, flash drive, or the like. The various software and/or firmware applications can be stored in the storage device 514, which can be executed by the signal processor 510 or another processor of the monitor 118. The network interface 516 can be a serial bus port (RS-232/RS-485), a Universal Serial Bus (USB) port, an Ethernet port, a wireless interface (e.g., Wi-Fi such as any 802.1x interface, including an internal wireless card), or other suitable communication device(s) that allows the monitor 118 to communicate and share data with other devices. The monitor 118 can also include various other components not shown, such as a microprocessor, graphics processor, or controller to output the user interface 112, to control data communications, to compute data trending, or to perform other operations. Poeze at [0129]

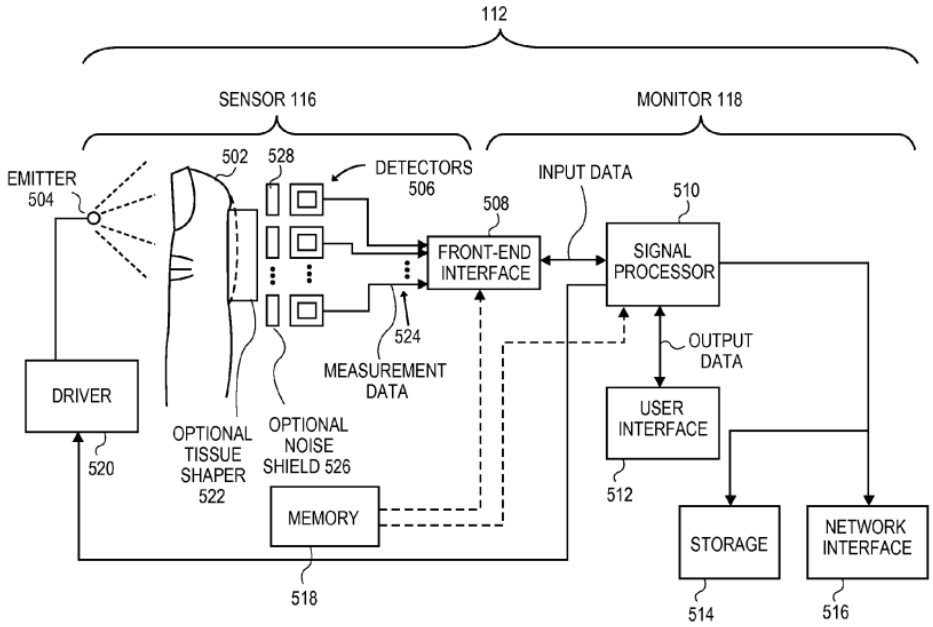
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g] synchronize to the light source,	Poeze discloses or renders obvious the receiver configured to synchronize to the light source. The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver 520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million. Poeze at [0117]. The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can

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	advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122]. The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127]

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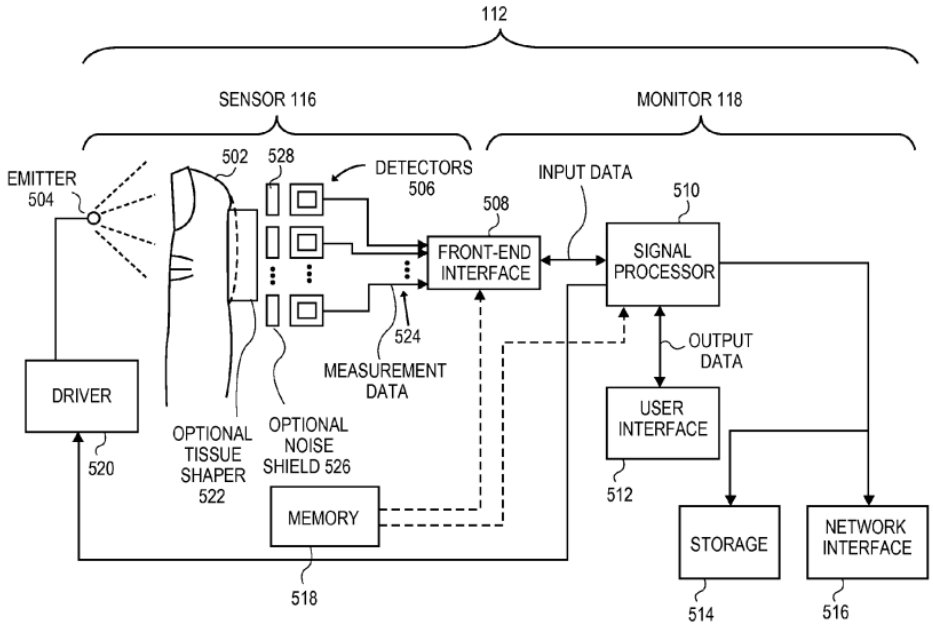
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	 **FIG. 8** Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h] capture light while the semiconductor sources are off and convert the captured light into a first signal,	Poeze discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal. The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide

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	pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118]. The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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11[i] capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Poeze discloses or renders obvious to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] The embodiment of the data collection device 112 shown also includes an optional noise shield 526. In an embodiment, the noise shield 526 can be advantageously adapted to reduce electromagnetic noise while increasing the transmittance of light from the measurement site 502 to one or more detectors 506 (described below). For example, the noise shield 526 can advantageously include a conductive coated glass or metal grid electrically communicating with one or more other shields of the sensor 116 or electrically grounded. In an embodiment where the noise shield 526 includes conductive coated glass, the coating can advantageously include indium tin oxide. In an embodiment, the indium tin oxide includes a surface resistivity ranging from approximately 30 ohms per square inch to about 500 ohms per square inch. In an embodiment, the resistivity is approximately 30, 200, or 500 ohms per square inch. As would be understood by a person of skill in the art from the present disclosure, other resistivities can also be used which are less than about 30 ohms or more than about 500 ohms. Other conductive materials transparent or substantially transparent to light can be used instead. Poeze at [0103]

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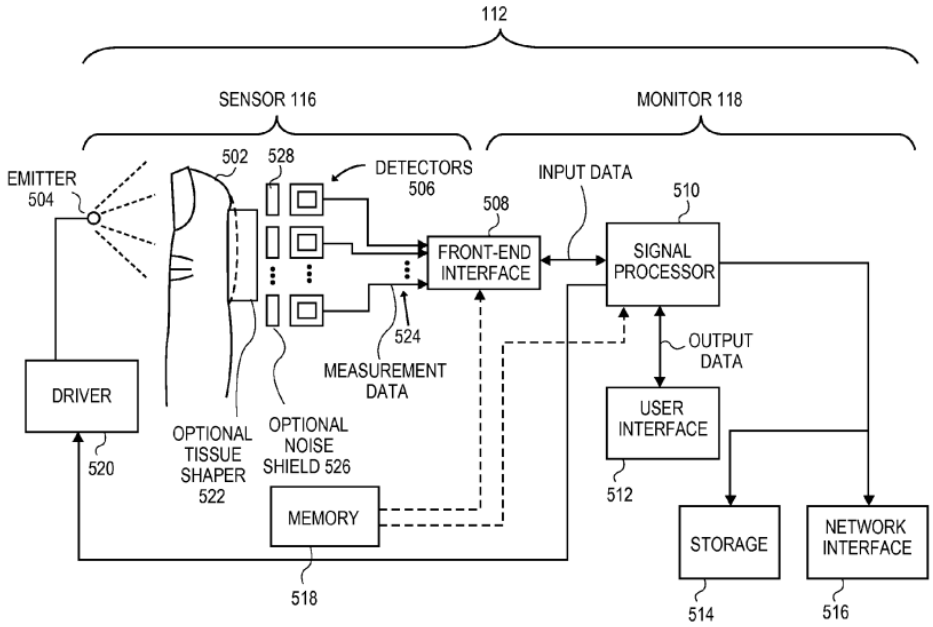
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	 **FIG. 8** Poeze at Fig. 8 The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected

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	from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120]. The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

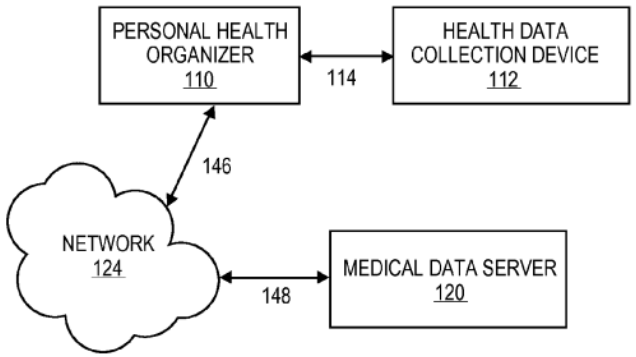
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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j] wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Poeze discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB) or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose. Poeze at [0100] The embodiment of the data collection device 112 shown also includes an optional noise shield 526. In an embodiment, the noise shield 526 can be advantageously adapted to reduce electromagnetic noise while increasing the transmittance of light from the measurement site 502 to one or more detectors 506 (described below). For example, the noise shield 526 can advantageously include a conductive coated glass or metal grid electrically communicating with one or more other shields of the sensor 116 or electrically grounded. In an embodiment where the noise shield 526 includes conductive coated glass, the coating can advantageously include indium tin oxide. In an embodiment, the indium tin oxide includes a surface resistivity ranging from approximately 30 ohms per square inch to about 500 ohms per square inch. In an embodiment, the resistivity is approximately 30, 200, or 500 ohms per square inch. As would be understood by a person of skill in the art from the present disclosure, other resistivities can also be used which are less than about 30 ohms or more than about 500 ohms. Other conductive materials transparent or substantially transparent to light can be used instead. Poeze at [0103]

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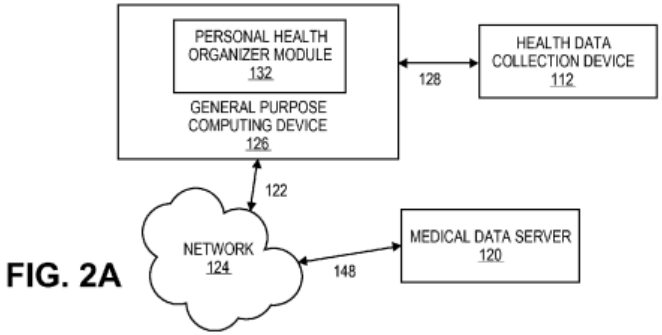
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	 **FIG. 8** Poeze at Fig. 8 The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a

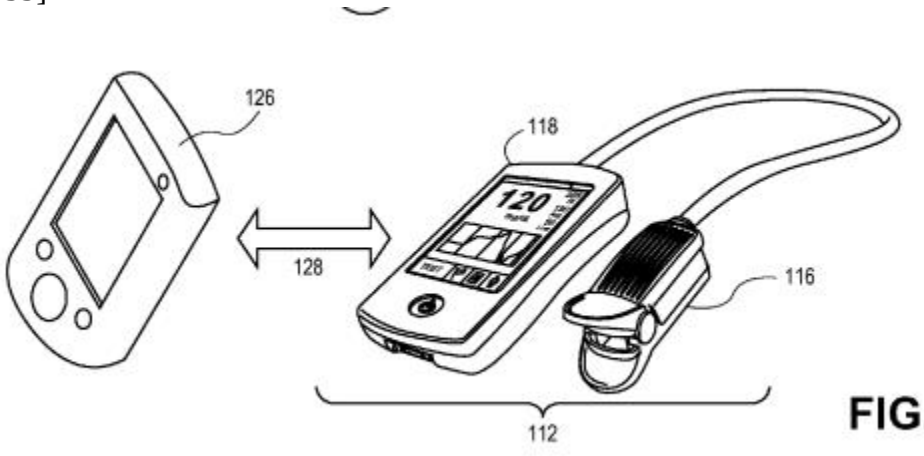
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	signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a	Poeze discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output

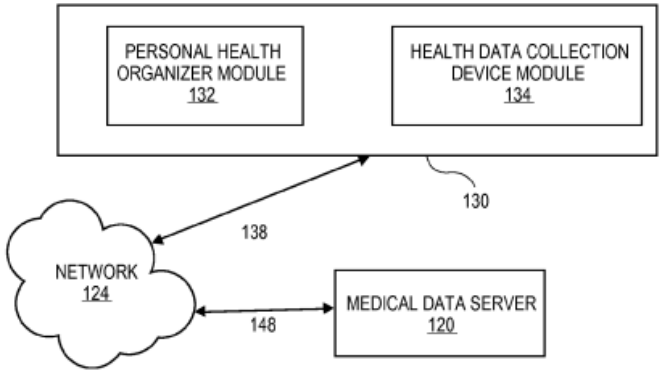
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microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. The personal health organizer 110 can comprise a computing system configured to perform functional tasks of various embodiments of the invention. For example, in an embodiment, the personal health organizer 110 accesses data collected by the health data collection device 112 or stored at a medical data server 120 connected via a network 124, which can include a LAN, WAN, or the Internet. The medical data server 120 and the personal health organizer 110 can be connected to the network via communications links 146 and 148, respectively, and the communications links can include wired or wireless connections. The medical data server 120 can be a conventional, preexisting data system operated by an entity such as a hospital or an insurance company. Poeze at [0030]  FIG. 1A Poeze at Fig. 1a. In the embodiment depicted in FIG. 1B, the health data collection device 112 includes a finger clip sensor 116 connected to a monitor 118 via a cable. Moreover, the monitor 118 can advantageously includes electronic processing, signal processing, and data storage devices capable of receiving signal data from the sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values,

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	trends of the measurement values, combinations of measurement values, and the like. Alternatively, in an embodiment, the personal health organizer 110 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the personal health organizer 110, and in that embodiment the personal health organizer 110 includes components and devices for processing the signal data from the sensor 116. Poeze at [0031] The monitor 118 can also include other components, such as a speaker, a power button, removable storage or memory (e.g., a flash card slot), an AC or DC power port, and one or more network interfaces, such as a universal serial bus (USB) interface, an Ethernet port, or a wireless port. These interfaces and ports can be used by the monitor 118 in one embodiment to communicate with the sensor 116 via a communication link 104, which may include various types of communication protocols and links as described above with respect to the communication link 114. For example, the monitor 118 can include a display that can indicate a measurement for glucose, for example, in mg/dL. Other analytes and forms of display can also appear on the monitor 118. Poeze at [0032] In addition, although a single sensor with a single monitor 118 is shown, different combinations of sensors and device pairings can be implemented. For example, multiple sensors can be provided for a plurality of differing patient types or measurement sites or even patient fingers. The sensor 116 can also connect to the monitor 118 wirelessly. Alternatively, the sensor 116 and the monitor 118 can be integrated into a single unit. A skilled artisan would appreciate that many other monitoring device configurations can be used as well. Poeze at [0033] FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a

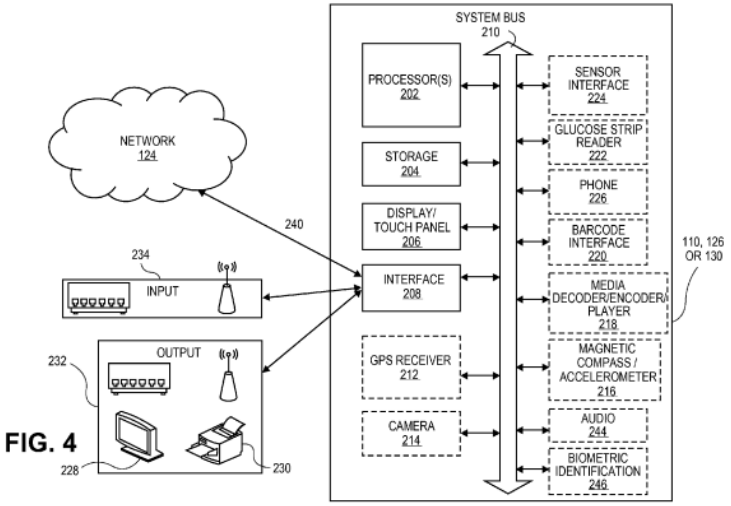
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	personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034]  FIG. 2A Poeze at Fig.2a. As shown in FIG. 2B, the general computing device 126 can be coupled with the health data collection device 112, with the monitor 118 and sensor 116 as described above. In the embodiments shown in FIGS. 1A, 1B, 2A, and 2B, the communication and/or I/O interfaces of the health data collection device 112 can be used to connect to personal health organizer 110 or 126. For example, the USB interface could be used to connect the monitor 118 to a USB port of the personal health organizer 110 or 126. As another example, the wireless port of the health data collection device 112 could be used to communicate with the personal health organizer via a wireless link, such as an RF or infrared link or a Bluetooth® link. A skilled artisan will appreciate that a variety of other configurations and communication mechanisms are possible. For example, in an embodiment, general purpose computer device 126 includes a sensor port

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	that allows for a sensor such as the sensor 116 to be connected directly to the general purpose computer device 126, and in that embodiment the general purpose computer device 126 includes components and devices for processing the signal data from the sensor 116. In another embodiment, the sensor 116 can be connected wirelessly to the general purpose computer device 126 through one or more known wireless connection protocols such as Bluetooth®. A skilled artisan will also appreciate that connecting the monitor 118 to the personal health organizer can allow the personal health organizer to collect, store, or analyze the output measurement values produced by the monitor 118. Poeze at [0035]  FIG. 2B Poeze at Fig.2b FIG. 3A depicts another embodiment with a personal health organizer software module 132 executed on a computing device 130 that is integrated with a health data collection device module 134. In an embodiment, the health data collection device module 134 is configured to collect physiological data such as glucose reading and other physiological parameters. In an embodiment, the health data collection device module 134 includes components and devices for processing the signal data from the sensor 116. As shown in FIG. 3B, the integrated device 130 can include a monitor display and a sensor 116. The monitor display can provide for display for both the personal health organizer software module 132 and the health data collection device module 134. In an embodiment, the sensor 116 can be further integrated into the integrated device 130. In another embodiment, the wire connecting the sensor 116 to the integrated device 130 can be retractable or detachable so that the sensor 116 can be housed within the integrated device 130 or elsewhere when the sensor 116 is not in use. In the detachable embodiment, the

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	integrated device 130 includes a sensor port that allows for the sensor 116 to be connected directly to the integrated device 130 through one or more known connection/communication protocols including USB and Ethernet. The sensor 116 can also connect wirelessly to the integrated device 130. Poeze at [0036]  FIG. 3A Poeze at fig. 3a. In one or more embodiments, the personal health organizer 110, 126 or 130 can be covered by a water-proof case (e.g. a case that can withstand water pressure up to 300M in depth). In an embodiment, the sensor 116 is either detached from the personal health organizer device or integrated into the personal health organizer within the water-proof case. The case can allow, for example, divers to use the personal health organizer under water. Poeze at [0037] Although a single personal health organizer is depicted in FIGS. 1A-3B, many different personal health organizers, monitoring devices, or sensors that operate as described above can be provided. In addition, multiple distinct healthcare entities and systems can communicate with a personal health organizer and its associated monitoring device and/or sensor. This can include corporate two-way interaction of data hubs such as Google Health, Microsoft Health Vault, and hubs maintained by WellPoint or other insurers.

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	One skilled in the art will appreciate that any number of patients or healthcare professionals can be provided access to the personal health organizer 110, 126, or 130 or the data server 120. Poeze at [0038] FIG. 4 illustrates in more detail components of an example personal health organizer 110, general computing device 126 (with a personal health organizer module 132) or integrated device 130 in accordance with various embodiments (hereinafter referred to as “personal health organizer”). In an embodiment, the components are divided into required components and optional components. In FIG. 4, the required components are illustrated in blocks with continuous lines while the optional components are illustrated in blocks with dotted lines. Poeze at [0039] As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the following components: one or more computer processor(s) 202, a storage 204, a display/touch panel 206, and an interface 208. One or more of these components can be connected together via a system bus 210. In an embodiment, the storage 204 includes (1) data storage such as a hard disk and/or removable media such as a flash drive, and/or (2) memory storage such as RAM or ROM. The processor(s) 202 can process signals received from a sensor such as the sensor 116 shown in FIGS. 1B, 2B, and 3B and derive physiological readings such as blood glucose level or other parameters from the signals. The storage 204 can include instructions or data for performing one or more methods disclosed herein. In one or more embodiments, the storage 204 includes a media card reader interface that accepts a media card such as an SD card, a microSD card, a memory stick, a CF card and the like. The portable media card can be used to store patient information and enable the personal health organizer device to be shared, with the settings and data for the individual user stored in the user's media card. The personal health organizer can also include a biometric identification module (such as a vein pattern or finger print scanner) 246 to distinguish one user from another or provide security for information stored. Poeze at [0040].

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	 FIG. 4 Poeze at fig. 4. In an embodiment, a personal health organizer computing platform/module 300 and related modules (shown in FIG. 5) are stored in storage 204 and executed on the processor 202. Additionally, the personal health organizer can access information including patient medical and reading data stored in storage 204 in performing methods disclosed herein. Poeze at [0041] The interface 208 can include an input 234, which can in turn include wired and wireless input connections in accordance with various protocols such USB, serial, parallel, SATA, Firewire (IEEE 1394), Bluetooth®, Wi-Fi, WiMAX, Wireless USB, ZIGBEE, etc. Although interface 208 is shown as a simple interface, multiple interfaces could be used. For example, the interface can include one or more commonly available input/output (I/O) interfaces that provide a communication interface to various external devices, connected via a wired, wireless, or combination of wired and wireless, communication link. In addition, sensor interface 224 can double as a wired interface to other connection types. Poeze at [0042]

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	The input 234 can also accept input from an input device such as a keyboard, a mouse, a speech recognition device, a touch screen device and/or other data entering devices. In an embodiment, the user inputs information through the touch screen functionality integrated into the display/touch panel 206. The input 234 can be connected to the health data collection device 112, other medical devices, other computing devices, etc. to collect medical and/or physiological reading data that is to be processed, analyzed, and/or communicated. Poeze at [0043] In an embodiment, the interface 208 also includes a network interface 240 that can receive information over any type of network, such as a telephony-based network (e.g., PBX or POTS), a local area network (LAN), a wide area network (WAN), a dedicated intranet, and/or the Internet. The network interface 240 can include a wired interface such as an Ethernet interface or a wireless interface such as Wi-Fi or WiMAX. Poeze at [0044] The personal health organizer can be adapted to provide output information to an output 232, with the information output through wired and wireless connections in accordance with various protocols such USB, serial, parallel, SATA, Firewire, Bluetooth®, Wi-Fi, WiMAX, Wireless USB, ZIGBEE, etc. Information can also be output to an external display 228 and/or a printer 230. Poeze at [0045] As further described below, the personal health organizer can use the stored patient information to generate reports, alerts, and the like for healthcare providers. The personal health organizer can then output the medical information via the output 232 and/or send the medical information through via the network 124. Poeze at [0046] The storage 204 can store personal data associated with patients connected to the personal health organizer, such as name, address, telephone number, driver's license number, social security number,

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	credit card account number, checking account number, age, gender, ethnicity, etc. Sensitive or personal data may be stored in an encrypted format and/or not stored on the personal health organizer. In an embodiment, the user is provided with data storage and security options and can configure the device as desired. In an embodiment, information stored on the device can be remotely wiped, for example, if the device is lost or stolen. The storage 204 can preferably also include records of reports generated for the healthcare providers (when a provider is the user) or patients, alerts generated for the healthcare providers or patients, patients associated with the healthcare providers, and requests made by the healthcare providers or patients. The storage 204 can also include the healthcare provider's or patient's membership identification (“ID”) and password. The information to be stored in the storage 204 can be entered, obtained, or transmitted using the touch screen enabled display 206, the input and output 232 and 234, and/or the network interface 240. Poeze at [0047]. The personal health organizer in an embodiment includes one or more of: a media decoder/encoder/player 218 for playing back music and media, a phone 226, a built-in video/still capability camera 214, a barcode interface 220, a magnetic compass/accelerometer 216, a sensor interface 224, a glucose strip reader 222, a biometric identification module (such as a retinal, vein pattern, or finger-print scanner) 246, and an audio component 244. The media player 218 can play back media such as music and video via a media center software displayed on the display 206. The camera 214 can support a document scanner that allows user to input documents and forms from healthcare providers or insurance companies. In an embodiment, the camera is paired with an optical character recognition module so that scanned medical forms can be converted into data that can be uploaded for synchronization at a server in a network (e.g. a cloud computing network) or stored on the personal health organizer device. The scanner can also enable the user to fill out a medical form and send the completed form to a healthcare provider or an insurance company. User can also photograph or scan the bar code of prescriptions and food packaging to obtain information on drug and nutrition. Poeze at [0048]. The sensor interface 224 can be used to connect to a health data collection device and/or a sensor such as the sensor 116 shown in FIGS. 1A-3B to obtain reading data from the device or sensor. The glucose strip reader 222 can be used to read/scan glucose strips and obtain reading data from the strips. The barcode interface 220 can be used for distinguishing patient records in a hospital setting.

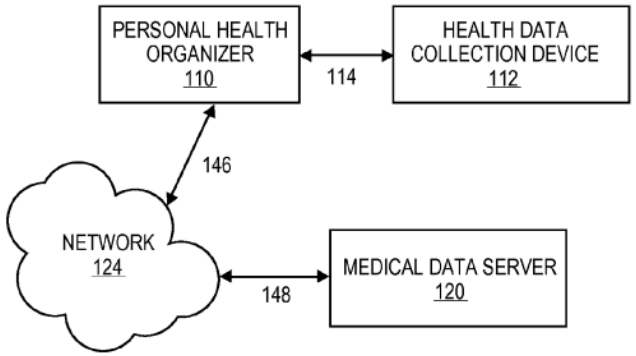
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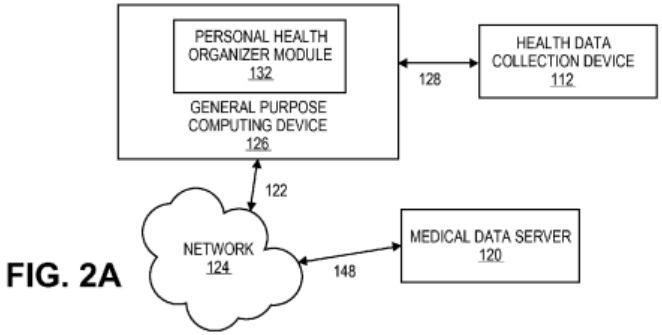
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	Poeze at [0049]. The personal health organizer can also include a GPS receiver component 212, which can determine the location of the personal health organizer. The GPS receiver component 212 can include a digital GPS receiver that can determine the location of the personal health organizer by determining coordinates, such as latitude, longitude, altimeter, etc. using conventional methods know in the art. In the case of an emergency associated with a user of the personal health organizer, emergency services or address book contacts can be contacted and location information of the user can be given by the personal health organizer using information provided by the GPS receiver component 212. In addition, the personal health organizer can be adapted to locate and discover nearby healthcare facilities and/or computing devices. For instance, the personal health organizer can determine its location as discussed above, and from knowing its location it could determine the closest hospital or pharmacy, etc. The personal health organizer can also determine what medical devices, equipment, monitors, and/or other computing devices are located near it, for example, by using the broadcast IDs of these devices (e.g. Wi-Fi SSIDs). Poeze at [0050]. In an embodiment, the magnetic compass/accelerometer component 216 enables a virtual reality capability. For example, a panoramic photo can be viewed on the display 206 by tilting/rotating the device, where the device updates the current viewing angle of the picture using the 3D acceleration vector from the accelerometer and the direction from the magnetic compass. In an embodiment, other accelerometer-related features include an orientation aware graphic user interface (GUI) on the display 206, whereby the GUI adjusts according to the physical orientation of the personal health organizer device. In another embodiment, the GUI provides a hospital navigational feature that can assist a user with navigating or routing through a hospital, for example, using a virtual reality depiction of the hospital. In addition, the display 206 can be configured so that a “Portrait View” is used to display numbers and a “Horizontal/Landscape” view is used to view full screen trended data (e.g. readings tracked over a period of time). Both view options can be overridden in the control menu of the personal health organizer device. While in the “trend view,” in an embodiment, the user can slide the trend timeline along a horizontal axis shake of the device, which can be taken to be a user generated gesture interaction with the device. In another embodiment, the user can rapidly shake the personal health organizer device and press the power button shortly to clear the trend that is being viewed. In another embodiment, the user can control or access the scroll menu with a vertical axis shake. An icon can be displayed to show a 2D

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	bubble level and/or a 3D bubble level to give the user feedback that the device is being used in a good orientation for use. Poeze at [0051]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Poeze discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. Systems, methods, and computer-readable media are disclosed for obtaining and analyzing medical data from a medical device or a data server. More specifically, systems, methods, and computer readable media are disclosed for enabling a portable device to obtain and analyze medical data from a health data collection device, such as a glucometer. Poeze at [0027]. The personal health organizer 110 can comprise a computing system configured to perform functional tasks of various embodiments of the invention. For example, in an embodiment, the personal health organizer 110 accesses data collected by the health data collection device 112 or stored at a medical data server 120 connected via a network 124, which can include a LAN, WAN, or the Internet. The medical data server 120 and the personal health organizer 110 can be connected to the network via communications links 146 and 148, respectively, and the communications links can include wired or wireless connections. The medical data server 120 can be a conventional, preexisting data system operated by an entity such as a hospital or an insurance company.

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	Poeze at [0030]  FIG. 1A Poeze at Fig. 1A. FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034]

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	 FIG. 2A Poeze at Fig.2a. Although a single personal health organizer is depicted in FIGS. 1A-3B, many different personal health organizers, monitoring devices, or sensors that operate as described above can be provided. In addition, multiple distinct healthcare entities and systems can communicate with a personal health organizer and its associated monitoring device and/or sensor. This can include corporate two-way interaction of data hubs such as Google Health, Microsoft Health Vault, and hubs maintained by WellPoint or other insurers. One skilled in the art will appreciate that any number of patients or healthcare professionals can be provided access to the personal health organizer 110, 126, or 130 or the data server 120. Poeze at [0038]. The personal health organizer in an embodiment includes one or more of: a media decoder/encoder/player 218 for playing back music and media, a phone 226, a built-in video/still capability camera 214, a barcode interface 220, a magnetic compass/accelerometer 216, a sensor interface 224, a glucose strip reader 222, a biometric identification module (such as a retinal, vein pattern, or finger-print scanner) 246, and an audio component 244. The media player 218 can play back media such as music and video via a media center software displayed on the display 206. The camera 214 can support a document scanner that allows user to input documents and forms from healthcare providers or insurance companies. In an embodiment, the camera is paired with an optical character recognition module so that scanned medical forms can be converted into data that can be uploaded for synchronization at a server in a network (e.g. a cloud computing network) or stored on the personal health

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	organizer device. The scanner can also enable the user to fill out a medical form and send the completed form to a healthcare provider or an insurance company. User can also photograph or scan the bar code of prescriptions and food packaging to obtain information on drug and nutrition. Poeze at [0048]. One embodiment of the personal health organizer includes an “auto-start” feature in which, after power on, the motion sensor and sensor 116 detects if a finger is placed and held steady for a time period (e.g. two seconds) at the sensor 116. If so, the device starts the measurement and can optionally upload the result to a server. In an embodiment, the auto-start feature can be paired with audible instructions, sent via the audio component 244, to assist the user in using the device in auto-start mode. Poeze at [0056]. In addition to analyzing reading data and providing the user with reminders, alerts, and other feedback to improve the user's health, the personal health organizer in an embodiment includes the electronic medical data record integration module 322 and/or the network computing support module 302 to assist in medical data synchronization. For example, the electronic medical data record integration module 322 can provide data backup and synchronization of medical results, contacts, and other user data (music, videos, etc.). The electronic medical data record integration module 322 can also be configured to enable synchronization of emails, text messages, and voice messages. The electronic medical data record integration module 322 and/or the network computing support module 302 can also be configured to synchronize patient data to centralized medical data servers such as Google Health, Microsoft Health Vault, etc. Poeze at [0068]. None, some, or all of the information relating to patient interactions with the personal health organizer can be sent electronically. For example, emails may be sent to those patients (e.g. an outpatient) that may take measurements on their own or have them taken by a non-professional caregiver such a family member. Emails, text messages, or other electronic communications can also include reminders, requests for data, advice based on data obtained, or any other similar personal or medical information. Poeze at [0077].

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Poeze discloses or renders obvious wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. The personal health organizer device of claim 7, wherein the health alert is generated when the physiological reading data indicates that a blood glucose level is below or above a pre-determined threshold. Poeze at claim 8. A computer readable medium having a computer executable personal health organizer module for analyzing and integrating medical data, the personal health organizer module comprising: a medical data input module configured to receive physiological reading data from a health data collection device or derive reading data from signal received from a sensor; an electronic medical data integration module configured to send the physiological reading data to a remote entity via a network; a medical data analysis module configured to analyze the reading data based on medical data stored in a storage of a general purpose computing device and update the medical data based on the result of the analysis; and a network computing support module configured to synchronize medical data stored at the remote entity with the medical data that is stored in the storage of the general purpose computing device, wherein the personal health organizer module is executable on the general purpose computing device.

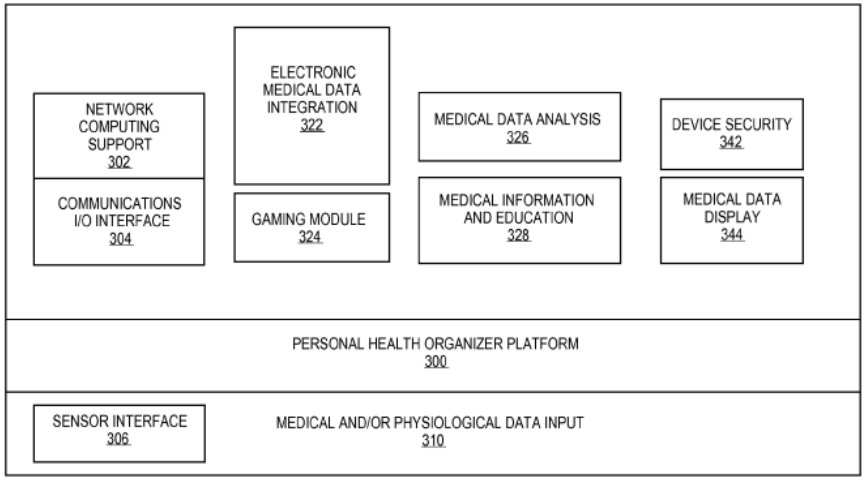
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	Poeze at claim 24. The computer readable medium of claim 26 wherein the general purpose computing device further comprises a GPS receiver component and wherein the medical data analysis module is configured to use the GPS receiver component to locate a nearby healthcare provider when the medical data analysis module determines the physiological reading data meets a pre-determined threshold. Poeze at claim 28. Systems, methods, and computer-readable media are disclosed for obtaining and analyzing medical data from a medical device or a data server. More specifically, systems, methods, and computer readable media are disclosed for enabling a portable device to obtain and analyze medical data from a health data collection device, such as a glucometer. Poeze at [0027] FIGS. 1A-1B, 2A-2B, and 3A-3B illustrate three primary embodiments of the personal health organizer. First, FIGS. 1A and 1B depict a dedicated portable personal health organizer device that is configured to receive data from a health data collection device such as a glucometer. In an embodiment, the personal health organizer is configured to analyze data from the collection device, manage the collected data, and use the collected data to assist the patient in managing his or her personal healthcare. For example, the collected data can be used to schedule reminders for the patient to visit his or her physician or pharmacist. Second, FIGS. 2A and 2B depict a general purpose computing device configured to execute a personal health organizer software module, with the computing device further configured to receive data from a health data collection device such as a glucometer. The general purpose computing device can be a mobile computing device with its own operating system and software, and has installed upon it the personal health organizer software module configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIGS. 1A and 1B. Finally, FIGS. 3A and 3B depict a device that integrates a personal health organizer software module with a health data collection device module, with the collection device module coupled with hardware to perform tasks of health data collection such as those performed by a glucometer or other patient monitoring device described above. Each of these primary embodiments will be described in further detail below.

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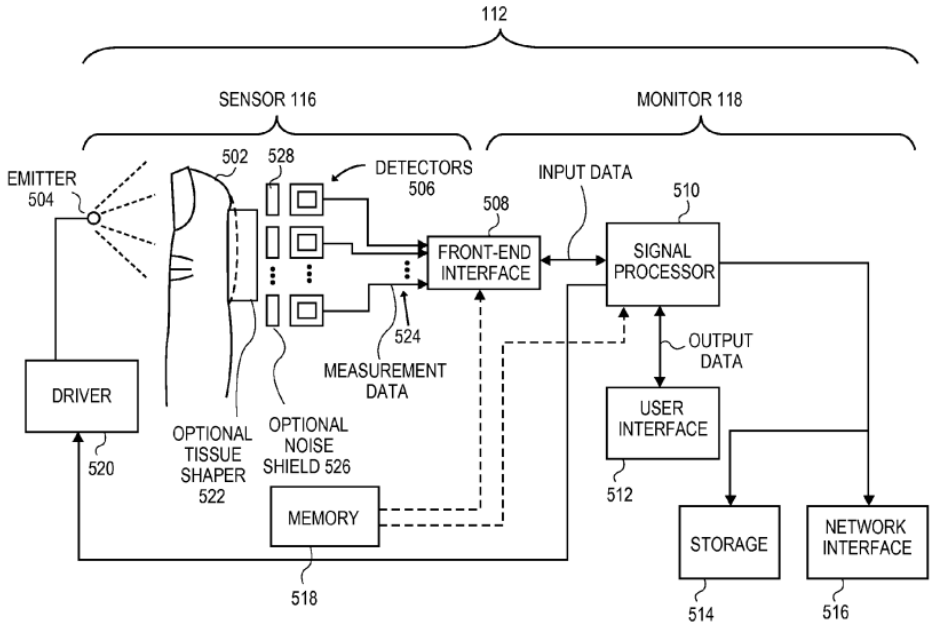
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	Poeze at [0028] As shown in FIG. 2B, the general computing device 126 can be coupled with the health data collection device 112, with the monitor 118 and sensor 116 as described above. In the embodiments shown in FIGS. 1A, 1B, 2A, and 2B, the communication and/or I/O interfaces of the health data collection device 112 can be used to connect to personal health organizer 110 or 126. For example, the USB interface could be used to connect the monitor 118 to a USB port of the personal health organizer 110 or 126. As another example, the wireless port of the health data collection device 112 could be used to communicate with the personal health organizer via a wireless link, such as an RF or infrared link or a Bluetooth® link. A skilled artisan will appreciate that a variety of other configurations and communication mechanisms are possible. For example, in an embodiment, general purpose computer device 126 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the general purpose computer device 126, and in that embodiment the general purpose computer device 126 includes components and devices for processing the signal data from the sensor 116. In another embodiment, the sensor 116 can be connected wirelessly to the general purpose computer device 126 through one or more known wireless connection protocols such as Bluetooth®. A skilled artisan will also appreciate that connecting the monitor 118 to the personal health organizer can allow the personal health organizer to collect, store, or analyze the output measurement values produced by the monitor 118. Poeze at [0035]. The input 234 can also accept input from an input device such as a keyboard, a mouse, a speech recognition device, a touch screen device and/or other data entering devices. In an embodiment, the user inputs information through the touch screen functionality integrated into the display/touch panel 206. The input 234 can be connected to the health data collection device 112, other medical devices, other computing devices, etc. to collect medical and/or physiological reading data that is to be processed, analyzed, and/or communicated. Poeze at [0043]. The personal health organizer in an embodiment includes one or more of: a media decoder/encoder/player 218 for playing back music and media, a phone 226, a built-in video/still capability camera 214, a barcode interface 220, a magnetic compass/accelerometer 216, a sensor interface 224, a glucose strip reader 222, a biometric identification module (such as a retinal, vein pattern,

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	or finger-print scanner) 246, and an audio component 244. The media player 218 can play back media such as music and video via a media center software displayed on the display 206. The camera 214 can support a document scanner that allows user to input documents and forms from healthcare providers or insurance companies. In an embodiment, the camera is paired with an optical character recognition module so that scanned medical forms can be converted into data that can be uploaded for synchronization at a server in a network (e.g. a cloud computing network) or stored on the personal health organizer device. The scanner can also enable the user to fill out a medical form and send the completed form to a healthcare provider or an insurance company. User can also photograph or scan the bar code of prescriptions and food packaging to obtain information on drug and nutrition. Poeze at [0048] The personal health organizer can include a device history log in which a user voluntarily provides access to log data so the manufacturer of the personal health organizer device can determine usage frequencies of various features. The log can be anonymized so that personal medical data is blacked out, blocked, or not provided. Poeze at [0054] The medical data analysis module 326, by way of example, can be used to receive medical or physiological data from the health data collection device 112 and/or the sensor 116. For example, the medical data analysis module 326 can be used to receive the measurement outputs from the monitor 118 in FIGS. 1B and 2B. As another example, the medical data analysis module 326 can be used to receive data from the sensor 116 in FIG. 3B. The medical data analysis module 326 can then analyze the data received from the sensor 116 to determine reading data and/or measurement values similar to those determined by the monitor 118. Poeze at [0059].

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	 **FIG. 5** Poeze at fig. 5. The medical data analysis module 326 can further include one or more sub-modules or programs for tracking medical data, including reading data and/or data related patient activities and correlating the medical data with patient activities. For example, the medical data analysis module 326 can track daily food intake that can be downloaded via network 124. In that embodiment, the medical data analysis module 326 is used to receive input from a user, via the input 234 and/or the display/touch panel 206, indicating food taken throughout the day. Then the medical data analysis module 326 can store the input in the storage 204, analyze the input to determine trends, and/or generate reports based on the input. This can help the physician, dietician, or patient to improve or modify dietary strategies for glucose control. In an embodiment, trending data is displayed to the user in various graphical formats on the display 206 through the medical data display module 344. Poeze at [0062]. As another example, the medical data analysis module 326 can track the glycemic index (GI), which describes the effect of carbohydrates on glucose level, and is sometimes used for medical nutrition therapy. In another embodiment, the medical data analysis module 326 can maintain a log of insulin

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	injections given and/or received to show a patient's compliance with medications. The insulin injections can be input by the user into the personal health organizer via the user interface on the display 206 or input automatically with digital syringe. The medical data analysis module 326 can also generate hypoglycemia or hyperglycemia alerts. For example, when the received reading data indicates that blood glucose is too low or too high, the medical data analysis module 326 can alert the patient and prompt the patient to log any symptoms of hypoglycemia or hyperglycemia. Moreover, the medical data analysis module 326 can have threshold reading values and/or accompanying symptom checklists configurable by a physician or a patient, so that if blood glucose values are detrimentally low or high and/or certain accompanying symptoms appear, alerts will be automatically sent to the patient's physician or emergency medical personnel. Similarly, the medical data analysis module 326 can determine if a user has missed a reading and it can send alerts (via SMS, email, automated voice call, etc.) to a friend, family member, or a caretaker to check on the user. Poeze at [0063]. In addition, the detectors 506 can be arranged with a spatial configuration to provide a variation of path lengths among at least some of the detectors 506. That is, some of the detectors 506 can have the substantially, or from the perspective of the processing algorithm, effectively, the same path length from the emitter 504. However, according to an embodiment, at least some of the detectors 506 can have a different path length from the emitter 504 relative to other of the detectors 506. Variations in path lengths can be helpful in allowing the use of a bulk signal stream from the detectors 506. In some embodiments, the detectors 506 may employ a linear spacing, a logarithmic spacing, or a two or three dimensional matrix of spacing, or any other spacing scheme in order to provide an appropriate variation in path lengths. Poeze at [0119]

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	 **FIG. 8** Poeze at Fig. 8 The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122]

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Poeze discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. The personal health organizer device of claim 7, wherein the health alert is generated when the physiological reading data indicates that a blood glucose level is below or above a pre-determined threshold. Poeze at claim 8. A computer readable medium having a computer executable personal health organizer module for analyzing and integrating medical data, the personal health organizer module comprising: a medical data input module configured to receive physiological reading data from a health data collection device or derive reading data from signal received from a sensor; an electronic medical data integration module configured to send the physiological reading data to a remote entity via a network; a medical data analysis module configured to analyze the reading data based on medical data stored in a storage of a general purpose computing device and update the medical data based on the result of the analysis; and a network computing support module configured to synchronize medical data stored at the remote entity with the medical data that is stored in the storage of the general purpose computing device, wherein the personal health organizer module is executable on the general purpose computing device. Poeze at claim 24.

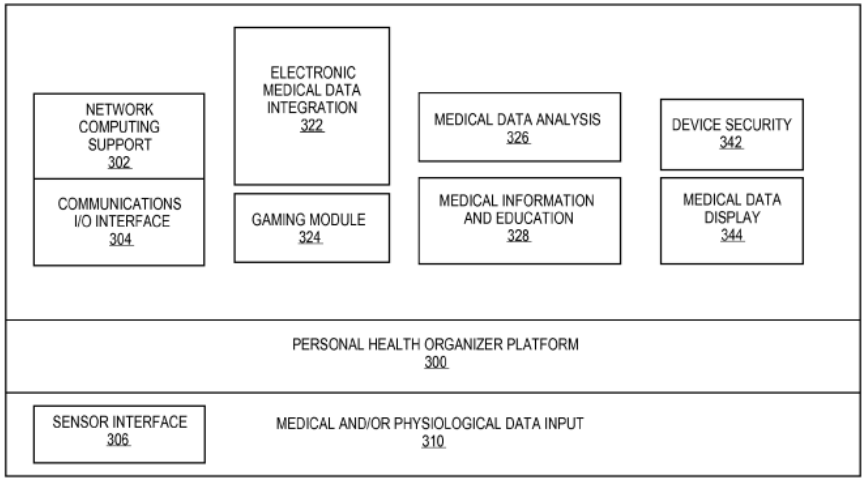
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	The computer readable medium of claim 26 wherein the general purpose computing device further comprises a GPS receiver component and wherein the medical data analysis module is configured to use the GPS receiver component to locate a nearby healthcare provider when the medical data analysis module determines the physiological reading data meets a pre-determined threshold. Poeze at claim 28. Systems, methods, and computer-readable media are disclosed for obtaining and analyzing medical data from a medical device or a data server. More specifically, systems, methods, and computer readable media are disclosed for enabling a portable device to obtain and analyze medical data from a health data collection device, such as a glucometer. Poeze at [0027] FIGS. 1A-1B, 2A-2B, and 3A-3B illustrate three primary embodiments of the personal health organizer. First, FIGS. 1A and 1B depict a dedicated portable personal health organizer device that is configured to receive data from a health data collection device such as a glucometer. In an embodiment, the personal health organizer is configured to analyze data from the collection device, manage the collected data, and use the collected data to assist the patient in managing his or her personal healthcare. For example, the collected data can be used to schedule reminders for the patient to visit his or her physician or pharmacist. Second, FIGS. 2A and 2B depict a general purpose computing device configured to execute a personal health organizer software module, with the computing device further configured to receive data from a health data collection device such as a glucometer. The general purpose computing device can be a mobile computing device with its own operating system and software, and has installed upon it the personal health organizer software module configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIGS. 1A and 1B. Finally, FIGS. 3A and 3B depict a device that integrates a personal health organizer software module with a health data collection device module, with the collection device module coupled with hardware to perform tasks of health data collection such as those performed by a glucometer or other patient monitoring device described above. Each of these primary embodiments will be described in further detail below. Poeze at [0028]

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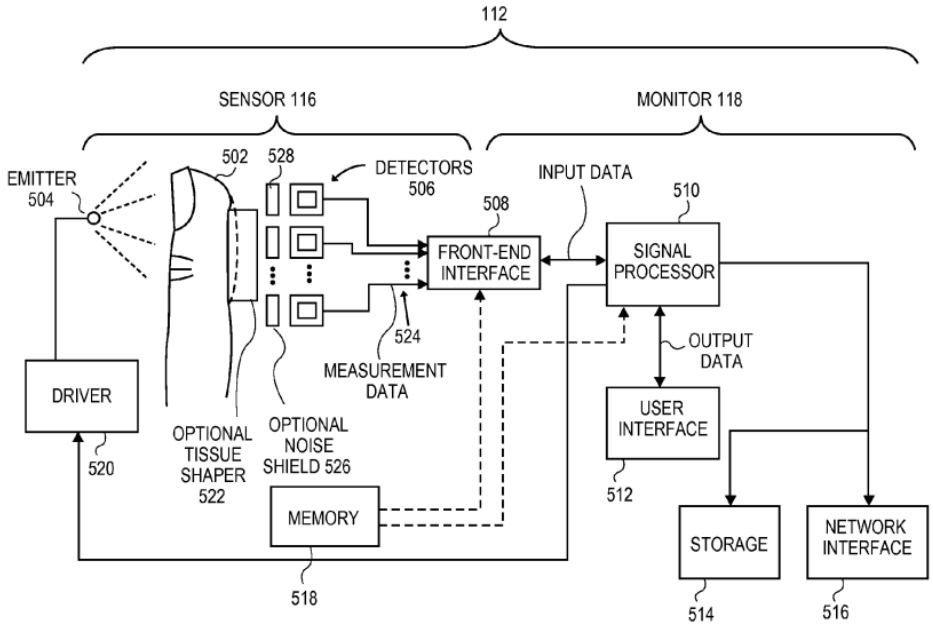
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	As shown in FIG. 2B, the general computing device 126 can be coupled with the health data collection device 112, with the monitor 118 and sensor 116 as described above. In the embodiments shown in FIGS. 1A, 1B, 2A, and 2B, the communication and/or I/O interfaces of the health data collection device 112 can be used to connect to personal health organizer 110 or 126. For example, the USB interface could be used to connect the monitor 118 to a USB port of the personal health organizer 110 or 126. As another example, the wireless port of the health data collection device 112 could be used to communicate with the personal health organizer via a wireless link, such as an RF or infrared link or a Bluetooth® link. A skilled artisan will appreciate that a variety of other configurations and communication mechanisms are possible. For example, in an embodiment, general purpose computer device 126 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the general purpose computer device 126, and in that embodiment the general purpose computer device 126 includes components and devices for processing the signal data from the sensor 116. In another embodiment, the sensor 116 can be connected wirelessly to the general purpose computer device 126 through one or more known wireless connection protocols such as Bluetooth®. A skilled artisan will also appreciate that connecting the monitor 118 to the personal health organizer can allow the personal health organizer to collect, store, or analyze the output measurement values produced by the monitor 118. Poeze at [0035]. The input 234 can also accept input from an input device such as a keyboard, a mouse, a speech recognition device, a touch screen device and/or other data entering devices. In an embodiment, the user inputs information through the touch screen functionality integrated into the display/touch panel 206. The input 234 can be connected to the health data collection device 112, other medical devices, other computing devices, etc. to collect medical and/or physiological reading data that is to be processed, analyzed, and/or communicated. Poeze at [0043]. The personal health organizer in an embodiment includes one or more of: a media decoder/encoder/player 218 for playing back music and media, a phone 226, a built-in video/still capability camera 214, a barcode interface 220, a magnetic compass/accelerometer 216, a sensor interface 224, a glucose strip reader 222, a biometric identification module (such as a retinal, vein pattern, or finger-print scanner) 246, and an audio component 244. The media player 218 can play back media such as music and video via a media center software displayed on the display 206. The camera 214 can

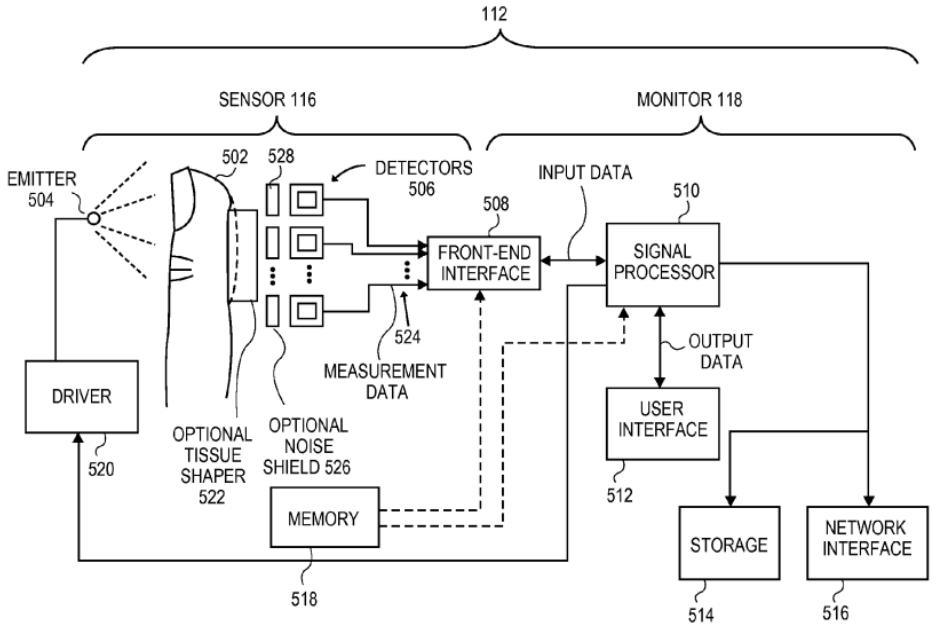
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	support a document scanner that allows user to input documents and forms from healthcare providers or insurance companies. In an embodiment, the camera is paired with an optical character recognition module so that scanned medical forms can be converted into data that can be uploaded for synchronization at a server in a network (e.g. a cloud computing network) or stored on the personal health organizer device. The scanner can also enable the user to fill out a medical form and send the completed form to a healthcare provider or an insurance company. User can also photograph or scan the bar code of prescriptions and food packaging to obtain information on drug and nutrition. Poeze at [0048] The personal health organizer can include a device history log in which a user voluntarily provides access to log data so the manufacturer of the personal health organizer device can determine usage frequencies of various features. The log can be anonymized so that personal medical data is blacked out, blocked, or not provided. Poeze at [0054] The medical data analysis module 326, by way of example, can be used to receive medical or physiological data from the health data collection device 112 and/or the sensor 116. For example, the medical data analysis module 326 can be used to receive the measurement outputs from the monitor 118 in FIGS. 1B and 2B. As another example, the medical data analysis module 326 can be used to receive data from the sensor 116 in FIG. 3B. The medical data analysis module 326 can then analyze the data received from the sensor 116 to determine reading data and/or measurement values similar to those determined by the monitor 118. Poeze at [0059]. The medical data analysis module 326 can further include one or more sub-modules or programs for tracking medical data, including reading data and/or data related patient activities and correlating the medical data with patient activities. For example, the medical data analysis module 326 can track daily food intake that can be downloaded via network 124. In that embodiment, the medical data analysis module 326 is used to receive input from a user, via the input 234 and/or the display/touch panel 206, indicating food taken throughout the day. Then the medical data analysis module 326 can store the input in the storage 204, analyze the input to determine trends, and/or generate reports based on the input. This

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	can help the physician, dietician, or patient to improve or modify dietary strategies for glucose control. In an embodiment, trending data is displayed to the user in various graphical formats on the display 206 through the medical data display module 344. Poeze at [0062].  **FIG. 5** Poeze at fig. 5. As another example, the medical data analysis module 326 can track the glycemic index (GI), which describes the effect of carbohydrates on glucose level, and is sometimes used for medical nutrition therapy. In another embodiment, the medical data analysis module 326 can maintain a log of insulin injections given and/or received to show a patient's compliance with medications. The insulin injections can be input by the user into the personal health organizer via the user interface on the display 206 or input automatically with digital syringe. The medical data analysis module 326 can also generate hypoglycemia or hyperglycemia alerts. For example, when the received reading data indicates that blood glucose is too low or too high, the medical data analysis module 326 can alert the patient and prompt the patient to log any symptoms of hypoglycemia or hyperglycemia. Moreover, the medical data analysis module 326 can have threshold reading values and/or accompanying symptom checklists configurable

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	by a physician or a patient, so that if blood glucose values are detrimentally low or high and/or certain accompanying symptoms appear, alerts will be automatically sent to the patient's physician or emergency medical personnel. Similarly, the medical data analysis module 326 can determine if a user has missed a reading and it can send alerts (via SMS, email, automated voice call, etc.) to a friend, family member, or a caretaker to check on the user. Poeze at [0063]. In addition, the detectors 506 can be arranged with a spatial configuration to provide a variation of path lengths among at least some of the detectors 506. That is, some of the detectors 506 can have the substantially, or from the perspective of the processing algorithm, effectively, the same path length from the emitter 504. However, according to an embodiment, at least some of the detectors 506 can have a different path length from the emitter 504 relative to other of the detectors 506. Variations in path lengths can be helpful in allowing the use of a bulk signal stream from the detectors 506. In some embodiments, the detectors 506 may employ a linear spacing, a logarithmic spacing, or a two or three dimensional matrix of spacing, or any other spacing scheme in order to provide an appropriate variation in path lengths. Poeze at [0119]

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	 **FIG. 8** Poeze at Fig. 8 The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122]

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	In addition, the detectors 506 can be arranged with a spatial configuration to provide a variation of path lengths among at least some of the detectors 506. That is, some of the detectors 506 can have the substantially, or from the perspective of the processing algorithm, effectively, the same path length from the emitter 504. However, according to an embodiment, at least some of the detectors 506 can have a different path length from the emitter 504 relative to other of the detectors 506. Variations in path lengths can be helpful in allowing the use of a bulk signal stream from the detectors 506. In some embodiments, the detectors 506 may employ a linear spacing, a logarithmic spacing, or a two or three dimensional matrix of spacing, or any other spacing scheme in order to provide an appropriate variation in path lengths. Poeze at [0119]  **FIG. 8** Poeze at Fig. 8

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	The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Poeze discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. The personal health organizer device of claim 7, wherein the health alert is generated when the physiological reading data indicates that a blood glucose level is below or above a pre-determined threshold. Poeze at claim 8. A computer readable medium having a computer executable personal health organizer module for analyzing and integrating medical data, the personal health organizer module comprising: a medical data input module configured to receive physiological reading data from a health data collection device or derive reading data from signal received from a sensor;

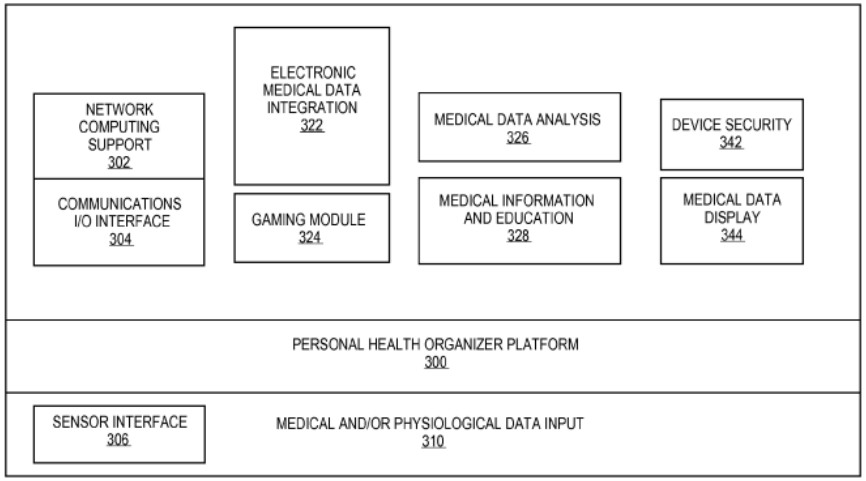
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	an electronic medical data integration module configured to send the physiological reading data to a remote entity via a network; a medical data analysis module configured to analyze the reading data based on medical data stored in a storage of a general purpose computing device and update the medical data based on the result of the analysis; and a network computing support module configured to synchronize medical data stored at the remote entity with the medical data that is stored in the storage of the general purpose computing device, wherein the personal health organizer module is executable on the general purpose computing device. Poeze at claim 24. The computer readable medium of claim 26 wherein the general purpose computing device further comprises a GPS receiver component and wherein the medical data analysis module is configured to use the GPS receiver component to locate a nearby healthcare provider when the medical data analysis module determines the physiological reading data meets a pre-determined threshold. Poeze at claim 28. Systems, methods, and computer-readable media are disclosed for obtaining and analyzing medical data from a medical device or a data server. More specifically, systems, methods, and computer readable media are disclosed for enabling a portable device to obtain and analyze medical data from a health data collection device, such as a glucometer. Poeze at [0027] FIGS. 1A-1B, 2A-2B, and 3A-3B illustrate three primary embodiments of the personal health organizer. First, FIGS. 1A and 1B depict a dedicated portable personal health organizer device that is configured to receive data from a health data collection device such as a glucometer. In an embodiment, the personal health organizer is configured to analyze data from the collection device, manage the collected data, and use the collected data to assist the patient in managing his or her personal healthcare. For example, the collected data can be used to schedule reminders for the patient to visit his or her physician or pharmacist. Second, FIGS. 2A and 2B depict a general purpose computing device configured to execute a personal health organizer software module, with the computing device further configured to receive data from a health data collection device such as a glucometer. The general purpose computing device can be a

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	mobile computing device with its own operating system and software, and has installed upon it the personal health organizer software module configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIGS. 1A and 1B. Finally, FIGS. 3A and 3B depict a device that integrates a personal health organizer software module with a health data collection device module, with the collection device module coupled with hardware to perform tasks of health data collection such as those performed by a glucometer or other patient monitoring device described above. Each of these primary embodiments will be described in further detail below. Poeze at [0028] In the embodiment depicted in FIG. 1B, the health data collection device 112 includes a finger clip sensor 116 connected to a monitor 118 via a cable. Moreover, the monitor 118 can advantageously includes electronic processing, signal processing, and data storage devices capable of receiving signal data from the sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Alternatively, in an embodiment, the personal health organizer 110 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the personal health organizer 110, and in that embodiment the personal health organizer 110 includes components and devices for processing the signal data from the sensor 116. Poeze at [0031] As shown in FIG. 2B, the general computing device 126 can be coupled with the health data collection device 112, with the monitor 118 and sensor 116 as described above. In the embodiments shown in FIGS. 1A, 1B, 2A, and 2B, the communication and/or I/O interfaces of the health data collection device 112 can be used to connect to personal health organizer 110 or 126. For example, the USB interface could be used to connect the monitor 118 to a USB port of the personal health organizer 110 or 126. As another example, the wireless port of the health data collection device 112 could be used to communicate with the personal health organizer via a wireless link, such as an RF or infrared link or a Bluetooth® link. A skilled artisan will appreciate that a variety of other configurations and communication mechanisms are possible. For example, in an embodiment, general purpose computer device 126 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the general purpose computer device 126, and in that embodiment the general purpose computer device 126 includes components and

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	devices for processing the signal data from the sensor 116. In another embodiment, the sensor 116 can be connected wirelessly to the general purpose computer device 126 through one or more known wireless connection protocols such as Bluetooth®. A skilled artisan will also appreciate that connecting the monitor 118 to the personal health organizer can allow the personal health organizer to collect, store, or analyze the output measurement values produced by the monitor 118. Poeze at [0035]. The input 234 can also accept input from an input device such as a keyboard, a mouse, a speech recognition device, a touch screen device and/or other data entering devices. In an embodiment, the user inputs information through the touch screen functionality integrated into the display/touch panel 206. The input 234 can be connected to the health data collection device 112, other medical devices, other computing devices, etc. to collect medical and/or physiological reading data that is to be processed, analyzed, and/or communicated. Poeze at [0043]. The personal health organizer in an embodiment includes one or more of: a media decoder/encoder/player 218 for playing back music and media, a phone 226, a built-in video/still capability camera 214, a barcode interface 220, a magnetic compass/accelerometer 216, a sensor interface 224, a glucose strip reader 222, a biometric identification module (such as a retinal, vein pattern, or finger-print scanner) 246, and an audio component 244. The media player 218 can play back media such as music and video via a media center software displayed on the display 206. The camera 214 can support a document scanner that allows user to input documents and forms from healthcare providers or insurance companies. In an embodiment, the camera is paired with an optical character recognition module so that scanned medical forms can be converted into data that can be uploaded for synchronization at a server in a network (e.g. a cloud computing network) or stored on the personal health organizer device. The scanner can also enable the user to fill out a medical form and send the completed form to a healthcare provider or an insurance company. User can also photograph or scan the bar code of prescriptions and food packaging to obtain information on drug and nutrition. Poeze at [0048]

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	The personal health organizer can include a device history log in which a user voluntarily provides access to log data so the manufacturer of the personal health organizer device can determine usage frequencies of various features. The log can be anonymized so that personal medical data is blacked out, blocked, or not provided. Poeze at [0054] The medical data analysis module 326, by way of example, can be used to receive medical or physiological data from the health data collection device 112 and/or the sensor 116. For example, the medical data analysis module 326 can be used to receive the measurement outputs from the monitor 118 in FIGS. 1B and 2B. As another example, the medical data analysis module 326 can be used to receive data from the sensor 116 in FIG. 3B. The medical data analysis module 326 can then analyze the data received from the sensor 116 to determine reading data and/or measurement values similar to those determined by the monitor 118. Poeze at [0059].  FIG. 5 Poeze at fig. 5.

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	The medical data analysis module 326 can further include one or more sub-modules or programs for tracking medical data, including reading data and/or data related patient activities and correlating the medical data with patient activities. For example, the medical data analysis module 326 can track daily food intake that can be downloaded via network 124. In that embodiment, the medical data analysis module 326 is used to receive input from a user, via the input 234 and/or the display/touch panel 206, indicating food taken throughout the day. Then the medical data analysis module 326 can store the input in the storage 204, analyze the input to determine trends, and/or generate reports based on the input. This can help the physician, dietician, or patient to improve or modify dietary strategies for glucose control. In an embodiment, trending data is displayed to the user in various graphical formats on the display 206 through the medical data display module 344. Poeze at [0062]. As another example, the medical data analysis module 326 can track the glycemic index (GI), which describes the effect of carbohydrates on glucose level, and is sometimes used for medical nutrition therapy. In another embodiment, the medical data analysis module 326 can maintain a log of insulin injections given and/or received to show a patient's compliance with medications. The insulin injections can be input by the user into the personal health organizer via the user interface on the display 206 or input automatically with digital syringe. The medical data analysis module 326 can also generate hypoglycemia or hyperglycemia alerts. For example, when the received reading data indicates that blood glucose is too low or too high, the medical data analysis module 326 can alert the patient and prompt the patient to log any symptoms of hypoglycemia or hyperglycemia. Moreover, the medical data analysis module 326 can have threshold reading values and/or accompanying symptom checklists configurable by a physician or a patient, so that if blood glucose values are detrimentally low or high and/or certain accompanying symptoms appear, alerts will be automatically sent to the patient's physician or emergency medical personnel. Similarly, the medical data analysis module 326 can determine if a user has missed a reading and it can send alerts (via SMS, email, automated voice call, etc.) to a friend, family member, or a caretaker to check on the user. Poeze at [0063]. FIG. 7 illustrates an example of a health data collection device 112. In the depicted embodiment, the monitoring device 118 includes a finger clip sensor 116 connected to a monitor 118 via a cable 452. In the embodiment shown, the monitor 118 includes a display 456, control buttons 454 and a power button.

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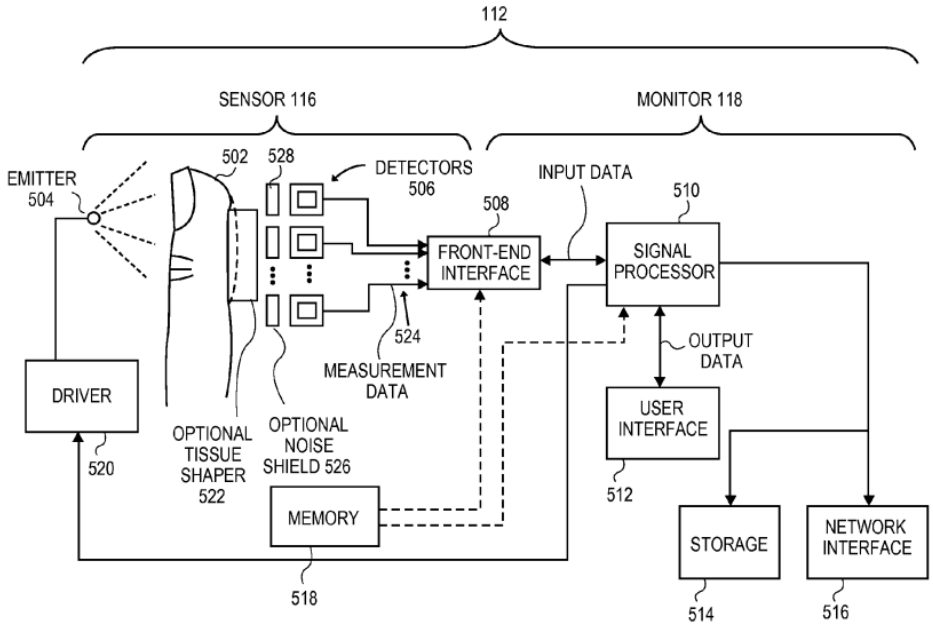
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	Moreover, the monitor 118 can advantageously include electronic processing, signal processing, and data storage devices capable of receiving signal data from said sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Poeze at [0093]. FIG. 8 is a block diagram that illustrates the components of an example of a health data collection device 112. In certain embodiments, the health data collection device 112 noninvasively measures a blood analyte, such as oxygen, carbon monoxide, methemoglobin, total hemoglobin, glucose, proteins, glucose, lipids, a percentage thereof (e.g., saturation) or for measuring many other physiologically relevant patient characteristics. The device 112 can also measure additional blood analytes and/or other physiological parameters useful in determining a state or trend of wellness of a patient. Poeze at [0098]. The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB) or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose. Poeze at [0100] The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101]

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	The embodiment of the data collection device 112 shown also includes an optional noise shield 526. In an embodiment, the noise shield 526 can be advantageously adapted to reduce electromagnetic noise while increasing the transmittance of light from the measurement site 502 to one or more detectors 506 (described below). For example, the noise shield 526 can advantageously include a conductive coated glass or metal grid electrically communicating with one or more other shields of the sensor 116 or electrically grounded. In an embodiment where the noise shield 526 includes conductive coated glass, the coating can advantageously include indium tin oxide. In an embodiment, the indium tin oxide includes a surface resistivity ranging from approximately 30 ohms per square inch to about 500 ohms per square inch. In an embodiment, the resistivity is approximately 30, 200, or 500 ohms per square inch. As would be understood by a person of skill in the art from the present disclosure, other resistivities can also be used which are less than about 30 ohms or more than about 500 ohms. Other conductive materials transparent or substantially transparent to light can be used instead. Poeze at [0103]. For analytes like glucose, currently available non-invasive techniques often attempt to employ light near the water absorbance minima at or about 1600 nm. Typically, these devices and methods employ a single wavelength or single band of wavelengths at or about 1600 nm. However, to date, these techniques have been unable to adequately consistently measure analytes like glucose based on spectroscopy. Poeze at [0108]. In contrast, the emitter 504 of the data collection device 112 can emit, in certain embodiments, combinations of optical radiation in various bands of interest. For example, in some embodiments, for analytes like glucose, the emitter 504 can emit optical radiation at three (3) or more wavelengths between about 1600 nm to about 1700 nm. In particular, the emitter 504 can emit optical radiation at or about 1610 nm, about 1640 nm, and about 1665 nm. In some circumstances, the use of three wavelengths within about 1600 nm to about 1700 nm enable sufficient SNRs of about 100 dB, which can result in a measurement accuracy of about 20 mg/dL or better for analytes like glucose. Poeze at [0109]. In other embodiments, the emitter 504 can use two (2) wavelengths within about 1600 nm to about 1700 nm to advantageously enable SNRs of about 85 dB, which can result in a measurement accuracy of about

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	25-30 mg/dL or better for analytes like glucose. Furthermore, in some embodiments, the emitter 504 can emit light at wavelengths above about 1670 nm. Measurements at these wavelengths can be advantageously used to compensate or confirm the contribution of protein, water, and other non-hemoglobin species exhibited in measurements for analytes like glucose conducted between about 1600 nm and about 1700 nm. Of course, other wavelengths and combinations of wavelengths can be used to measure analytes and/or to distinguish other types of tissue, fluids, tissue properties, fluid properties, combinations of the same or the like. Poeze at [0110]. For example, the emitter 504 can emit optical radiation across other spectra for other analytes. In particular, the emitter 504 can employ light wavelengths to measure various blood analytes or percentages (e.g., saturation) thereof. For example, in an embodiment, the emitter 504 can emit optical radiation in the form of pulses at wavelengths about 905 nm, about 1050 nm, about 1200 nm, about 1300 nm, about 1330 nm, about 1610 nm, about 1640 nm, and about 1665 nm. In another embodiment, the emitter 504 can emit optical radiation ranging from about 860 nm to about 950 nm, about 950 nm to about 1100 nm, about 1100 nm to about 1270 nm, about 1250 nm to about 1350 nm, about 1300 nm to about 1360 nm, and about 1590 nm to about 1700 nm. Of course, the emitter 504 can transmit any of a variety of wavelengths of visible or near-infrared optical radiation. Poeze at [0111].

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	 **FIG. 8** Poeze at Fig. 8 The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122]

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	The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120]. The front-end interface 508 can be coupled to the detectors 506 and to the signal processor 510 using a bus, wire, electrical or optical cable, flex circuit, or some other form of signal connection. The front-end interface 508 can also be at least partially integrated with various components, such as the detectors 506. For example, the front-end interface 508 can include one or more integrated circuits that are on the same circuit board as the detectors 506. Other configurations can also be used. Poeze at [0121]. The ADC or ADCs can provide one or more outputs into multiple channels of digital information for processing by the signal processor 510 of the monitor 118. Each channel can correspond to a signal output from a detector 506. Poeze at [0123]. In another embodiment, the front-end interface 508 can be implemented using switched-capacitor circuits. A switched-capacitor-based front-end interface 508 can be useful for, in certain embodiments, its resistor-free design and analog averaging properties. In addition, a switched-capacitor-based front-end interface 508 can be useful because it can provide a digital signal to the signal processor 510 in the monitor 118. Poeze at [0125].

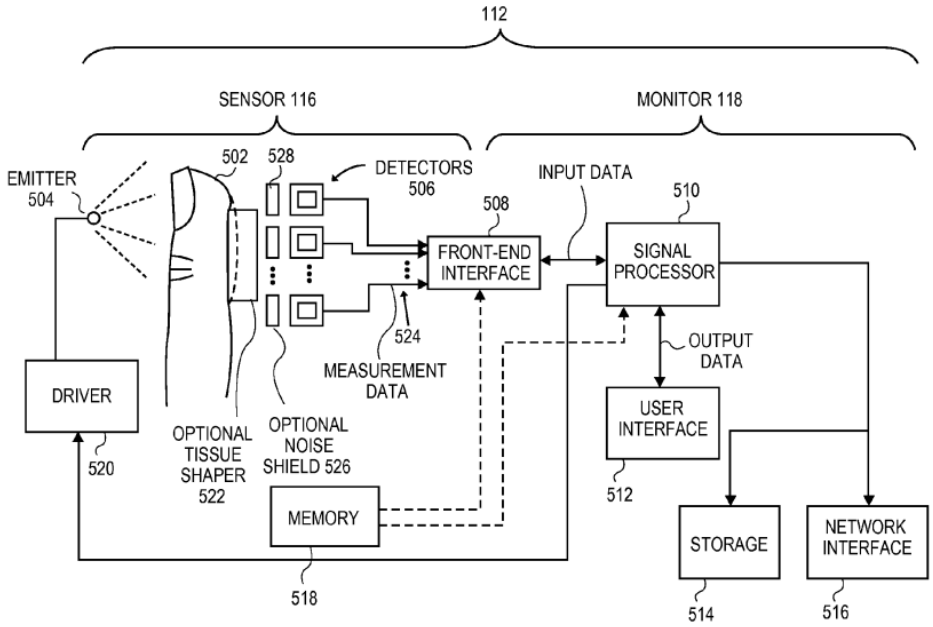
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	As shown in FIG. 8, the monitor 118 can include the signal processor 510 and a user interface, such as a display 512. The monitor 109 can also include optional outputs alone or in combination with the display 512, such as a storage device 514 and a network interface 516. In an embodiment, the signal processor 510 includes processing logic that determines measurements for desired analytes, such as glucose, based on the signals received from the detectors 506. The signal processor 510 can be implemented using one or more microprocessors or subprocessors (e.g., cores), digital signal processors, application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), combinations of the same, and the like. Poeze at [0126]. The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	

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13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Poeze discloses or renders obvious wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. The embodiment of the data collection device 112 shown also includes an optional noise shield 526. In an embodiment, the noise shield 526 can be advantageously adapted to reduce electromagnetic noise while increasing the transmittance of light from the measurement site 502 to one or more detectors 506 (described below). For example, the noise shield 526 can advantageously include a conductive coated glass or metal grid electrically communicating with one or more other shields of the sensor 116 or electrically grounded. In an embodiment where the noise shield 526 includes conductive coated glass, the coating can advantageously include indium tin oxide. In an embodiment, the indium tin oxide includes a surface resistivity ranging from approximately 30 ohms per square inch to about 500 ohms per square inch. In an embodiment, the resistivity is approximately 30, 200, or 500 ohms per square inch. As would be understood by a person of skill in the art from the present disclosure, other resistivities can also be used which are less than about 30 ohms or more than about 500 ohms. Other conductive materials transparent or substantially transparent to light can be used instead. Poeze at [0103]

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	 **FIG. 8** Poeze at Fig. 8 The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver

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	520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million. Poeze at [0117] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120]. The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122]. The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also

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	shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Poeze discloses or renders obvious wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above. In other embodiments, the personal health organizer includes an accelerometer that detects user motion and the motion can assist in the collection of and/or display of medical/reading data. For example, the accelerometer can detect a user's intent to use the device via touch/motion and automatically start the collection of data when the user places his or her finger into a sensor associated with a health collection data device. In another example, the personal health organizer can begin health data collection once the user places his or her finger into a sensor associated with a health collection data device and/or provides a gesture via a touch-screen input associated with the personal health organizer. In yet another example, the personal health organizer begins the data collection when the user places a finger into the sensor. The LEDs and photo diodes in the sensor can detect the presence of the finger and initiate data collection. The presence of a finger can be determined, for example, by determining when there is a significant reduction in detected light. Such a reduction in detected light can indicate the presence of a finger and start the data collection process.

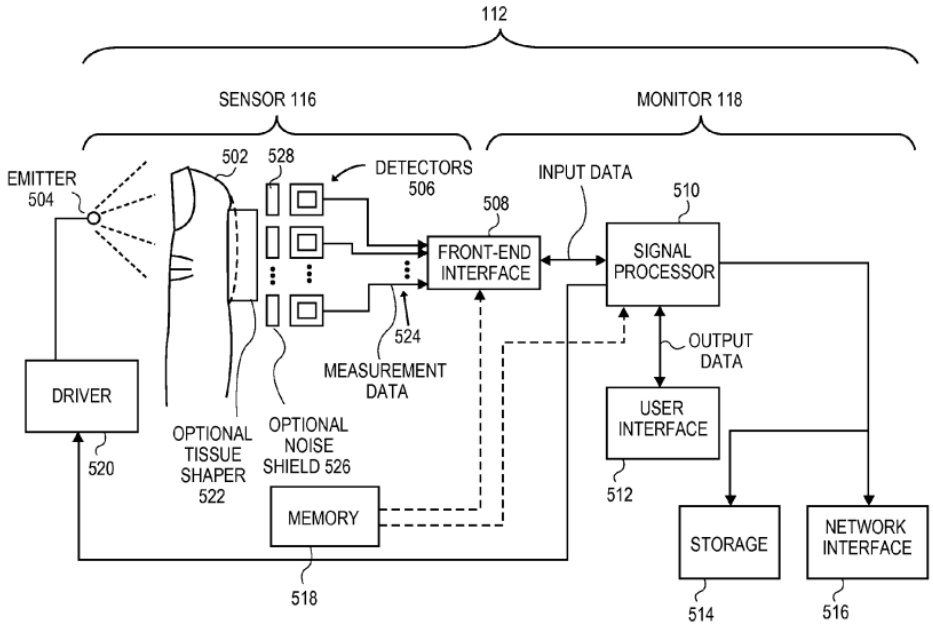
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	Poeze at [0013] The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] In the depicted embodiment, the device 112 includes an optional tissue thickness adjuster or tissue shaper 522, which can include one or more protrusions, bumps, lenses, or other suitable tissue-shaping mechanisms. In certain embodiments, the tissue shaper 522 is a flat or substantially flat surface that can be positioned proximate the measurement site 502 and that can apply sufficient pressure to cause the tissue of the measurement site 502 to be flat or substantially flat. In other embodiments, the tissue shaper 522 is a convex or substantially convex surface with respect to the measurement site 502. Many other configurations of the tissue shaper 522 are possible. Advantageously, in certain embodiments, the tissue shaper 522 reduces thickness of the measurement site 502 while preventing or reducing occlusion at the measurement site 502. Reducing thickness of the site can advantageously reduce the amount of attenuation of the light because there is less tissue through which the light must travel. Shaping the tissue in to a convex (or alternatively concave) surface can also provide more surface area from which light can be detected. Poeze at [0102]. In the depicted embodiment shown in FIG. 8, the sensor 116 includes an emitter 504, a tissue shaper 522, a set of detectors 506, and a front-end interface 508. The emitter 504 can serve as the source of optical radiation transmitted towards measurement site 102. As will be described in further detail below, the emitter 504 can include one or more sources of optical radiation, such as LEDs, laser diodes, incandescent bulbs with appropriate frequency-selective filters, combinations of the same, or the like. In an embodiment, the emitter 504 includes sets of optical sources that are capable of emitting visible and near-infrared optical radiation.

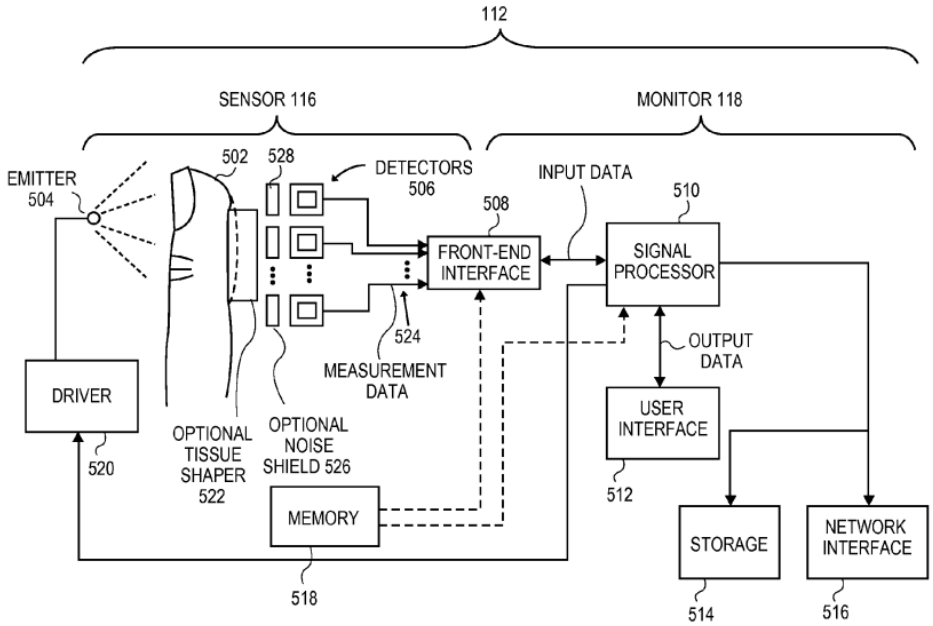
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	Poeze at [0106] As briefly described above, the emitter 504 can include sets of light-emitting diodes (LEDs) as its optical source. The emitter 504 can use one or more top-emitting LEDs. In particular, in some embodiments, the emitter 504 can include top-emitting LEDs emitting light at about 850 nm to 1350 nm. Poeze at [0113]. The emitter 504 can also use super luminescent LEDs (SLEDs) or side-emitting LEDs. In some embodiments, the emitter 504 can employ SLEDs or side-emitting LEDs to emit optical radiation at about 1600 nm to about 1700 nm. Emitter 504 can use SLEDs or side-emitting LEDs to transmit near infrared optical radiation because these types of sources can transmit at high power or relatively high power, e.g., about 40 mW to about 100 mW. This higher power capability can be useful to compensate or overcome the greater attenuation of these wavelengths of light in tissue and water. For example, the higher power emission can effectively compensate and/or normalize the absorption signal for light in the mentioned wavelengths to be similar in amplitude and/or effect as other wavelengths that can be detected by one or more photodetectors after absorption. However, the embodiments of the present disclosure do not necessarily require the use of high power optical sources. For example, some embodiments may be configured to measure analytes, such as total hemoglobin (tHb), oxygen saturation (SpO2), carboxyhemoglobin, methemoglobin, etc., without the use of high power optical sources like side emitting LEDs. Instead, such embodiments may employ other types of optical sources, such as top emitting LEDs. Alternatively, the emitter 504 can use other types of sources of optical radiation, such as a laser diode, to emit near-infrared light into the measurement site 502. Poeze at [0114] In addition, in some embodiments, in order to assist in achieving a comparative balance of desired power output between the LEDs, some of the LEDs in the emitter 504 can have a filter or covering that reduces and/or cleans the optical radiation from particular LEDs or groups of LEDs. For example, since some wavelengths of light can penetrate through tissue relatively well, LEDs, such as some or all of the top-emitting LEDs can use a filter or covering, such as a cap or painted dye. This can be useful in allowing the emitter 504 to use LEDs with a higher output and/or to equalize intensity of LEDs. Poeze at [0115].

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	The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118]  **FIG. 8** Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Poeze discloses or renders obvious wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above. In the depicted embodiment shown in FIG. 8, the sensor 116 includes an emitter 504, a tissue shaper 522, a set of detectors 506, and a front-end interface 508. The emitter 504 can serve as the source of optical radiation transmitted towards measurement site 102. As will be described in further detail below, the emitter 504 can include one or more sources of optical radiation, such as LEDs, laser diodes, incandescent bulbs with appropriate frequency-selective filters, combinations of the same, or the like. In an embodiment, the emitter 504 includes sets of optical sources that are capable of emitting visible and near-infrared optical radiation. Poeze at [0106] In some embodiments, the emitter 504 is used as a point optical source, and thus, the one or more optical sources of the emitter 504 can be located within a close distance to each other, such as within about a 2 mm to about 4 mm. The emitters 504 can be arranged in an array, such as is described in U.S. Publication No. 2006/0211924, filed Sep. 21, 2006, titled “Multiple Wavelength Sensor Emitters,” the disclosure of which is hereby incorporated by reference in its entirety. In particular, the emitters 504 can be arranged at least in part as described in paragraphs [0061] through [0068] of the aforementioned publication, which paragraphs are hereby incorporated specifically by reference. Other relative spatial relationships can be used to arrange the emitters 504. Poeze at [0107] In addition, the detectors 506 can be arranged with a spatial configuration to provide a variation of path lengths among at least some of the detectors 506. That is, some of the detectors 506 can have the

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	substantially, or from the perspective of the processing algorithm, effectively, the same path length from the emitter 504. However, according to an embodiment, at least some of the detectors 506 can have a different path length from the emitter 504 relative to other of the detectors 506. Variations in path lengths can be helpful in allowing the use of a bulk signal stream from the detectors 506. In some embodiments, the detectors 506 may employ a linear spacing, a logarithmic spacing, or a two or three dimensional matrix of spacing, or any other spacing scheme in order to provide an appropriate variation in path lengths. Poeze at [0119]  **FIG. 8** Poeze at Fig.8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Poeze discloses or renders obvious wherein the first arc and the second arc are concentric. *See* claim 15 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Poeze discloses or renders obvious a wearable device for use with a smart phone or tablet. *See* claim 11[a],11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of	Poeze discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters.

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semiconductor sources for measuring one or more physiological parameters,	*See* claim 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Poeze discloses or renders obvious the measurement device configured to generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths. In the depicted embodiment shown in FIG. 8, the sensor 116 includes an emitter 504, a tissue shaper 522, a set of detectors 506, and a front-end interface 508. The emitter 504 can serve as the source of optical radiation transmitted towards measurement site 102. As will be described in further detail below, the emitter 504 can include one or more sources of optical radiation, such as LEDs, laser diodes, incandescent bulbs with appropriate frequency-selective filters, combinations of the same, or the like. In an embodiment, the emitter 504 includes sets of optical sources that are capable of emitting visible and near-infrared optical radiation. Poeze at [0106] For example, the emitter 504 can emit optical radiation across other spectra for other analytes. In particular, the emitter 504 can employ light wavelengths to measure various blood analytes or percentages (e.g., saturation) thereof. For example, in an embodiment, the emitter 504 can emit optical radiation in the form of pulses at wavelengths about 905 nm, about 1050 nm, about 1200 nm, about 1300 nm, about 1330 nm, about 1610 nm, about 1640 nm, and about 1665 nm. In another embodiment, the emitter 504 can emit optical radiation ranging from about 860 nm to about 950 nm, about 950 nm to about 1100 nm, about 1100 nm to about 1270 nm, about 1250 nm to about 1350 nm, about 1300 nm to about 1360 nm, and about 1590 nm to about 1700 nm. Of course, the emitter 504 can transmit any of a variety of wavelengths of visible or near-infrared optical radiation.

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	Poeze at [0111] The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver 520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million. Poeze at [0117] The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122]. The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted

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	from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Poeze discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* claim 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;	Poeze discloses or renders obvious the receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal. And capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue; *See* claim 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Poeze discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor source. *See* claim 11[a], 11[b], 11[g], 19[a], 19[b], 19[d] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the	Poeze discloses or renders obvious a measurement device configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* claim 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]

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first signal and the second signal, and	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Poeze discloses or renders obvious increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* claim 11[a], 11[b], 11[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Poeze discloses or renders obvious a measurement device configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* claim 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Poeze discloses or renders obvious a measurement device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. FIGS. 1A-1B, 2A-2B, and 3A-3B illustrate three primary embodiments of the personal health organizer. First, FIGS. 1A and 1B depict a dedicated portable personal health organizer device that is configured to receive data from a health data collection device such as a glucometer. In an embodiment, the personal health organizer is configured to analyze data from the collection device, manage the collected data, and use the collected data to assist the patient in managing his or her personal healthcare. For example, the collected data can be used to schedule reminders for the patient to visit his or her physician or pharmacist. Second, FIGS. 2A and 2B depict a general purpose computing device configured to execute a personal health organizer software module, with the computing device further configured to receive data from a health data collection device such as a glucometer. The general purpose computing device can be a mobile computing device with its own operating system and software, and has installed upon it the personal health organizer software module configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIGS. 1A and 1B. Finally, FIGS. 3A and 3B depict a device that integrates a personal health organizer software module with a health data collection device module, with the collection device module coupled with hardware to perform tasks of health data collection such as those performed by a glucometer or other patient monitoring device described above. Each of these primary embodiments will be described in further detail below. Poeze at [0028] FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are

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	substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034] As shown in FIG. 2B, the general computing device 126 can be coupled with the health data collection device 112, with the monitor 118 and sensor 116 as described above. In the embodiments shown in FIGS. 1A, 1B, 2A, and 2B, the communication and/or I/O interfaces of the health data collection device 112 can be used to connect to personal health organizer 110 or 126. For example, the USB interface could be used to connect the monitor 118 to a USB port of the personal health organizer 110 or 126. As another example, the wireless port of the health data collection device 112 could be used to communicate with the personal health organizer via a wireless link, such as an RF or infrared link or a Bluetooth® link. A skilled artisan will appreciate that a variety of other configurations and communication mechanisms are possible. For example, in an embodiment, general purpose computer device 126 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the general purpose computer device 126, and in that embodiment the general purpose computer device 126 includes components and devices for processing the signal data from the sensor 116. In another embodiment, the sensor 116 can be connected wirelessly to the general purpose computer device 126 through one or more known wireless connection protocols such as Bluetooth®. A skilled artisan will also appreciate that connecting the monitor 118 to the personal health organizer can allow the personal health organizer to collect, store, or analyze the output measurement values produced by the monitor 118. Poeze at [0035] The personal health organizer in an embodiment includes one or more of: a media decoder/encoder/player 218 for playing back music and media, a phone 226, a built-in video/still capability camera 214, a barcode interface 220, a magnetic compass/accelerometer 216, a sensor interface 224, a glucose strip reader 222, a biometric identification module (such as a retinal, vein pattern, or finger-print scanner) 246, and an audio component 244. The media player 218 can play back media such as music and video via a media center software displayed on the display 206. The camera 214 can support a document scanner that allows user to input documents and forms from healthcare providers or insurance companies. In an embodiment, the camera is paired with an optical character recognition

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	module so that scanned medical forms can be converted into data that can be uploaded for synchronization at a server in a network (e.g. a cloud computing network) or stored on the personal health organizer device. The scanner can also enable the user to fill out a medical form and send the completed form to a healthcare provider or an insurance company. User can also photograph or scan the bar code of prescriptions and food packaging to obtain information on drug and nutrition. Poeze at [0048]. In another embodiment, the network computing support module 302 can be configured to provide reminders to the user if the personal health organizer is not with the user. For example, the user can call the personal health organizer via phone or send an email or text message with a particular question regarding appointment times, medication intake schedule, etc. In an embodiment, the personal health organizer or a data server with synchronized medical data records within a remote computing network (e.g. cloud computing network) provides answers to the particular questions sent. Poeze at [0073]. In an embodiment, the medical information and education module 328 includes one or more of the following sub-modules. First, it can include a gestational diabetes sub-module that allows for the integration of information and settings specific to the term of pregnancy and the user's concerns. The gestational diabetes sub-module can show pictures of the fetus in each stage of development, and can further be synchronized with the user's calendar and week by week progression. The sub-module can also assist with monitoring timers, medication reminders, and prenatal timers etc. Second, the medical information and education module 328 can include a “Personal Nurse Educator” sub-module. The sub-module can be paid for by an insurance company to provide a 24-hour nurse on call service, with the service specifically allowed to access the user's medical information stored within a remote computing network (e.g. cloud computing network), including data stored on the personal health organizer device. The sub-module enables the user to chat with, send text messages to, email, or phone (including video conference) the on-call nurse with specific questions. Poeze at [0088]. A computer readable medium having a computer executable personal health organizer module for analyzing and integrating medical data, the personal health organizer module comprising:

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	a medical data input module configured to receive physiological reading data from a health data collection device or derive reading data from signal received from a sensor; an electronic medical data integration module configured to send the physiological reading data to a remote entity via a network; a medical data analysis module configured to analyze the reading data based on medical data stored in a storage of a general purpose computing device and update the medical data based on the result of the analysis; and a network computing support module configured to synchronize medical data stored at the remote entity with the medical data that is stored in the storage of the general purpose computing device, wherein the personal health organizer module is executable on the general purpose computing device. Poeze at Claim 24. The computer readable medium of claim 24 wherein the general purpose computing device is a mobile computing device. Poeze at Claim 39. The computer readable medium of claim 39 wherein the mobile computing device is the iPhone manufactured by Apple Incorporated. Poeze at Claim 40. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to:	Poeze discloses or renders obvious the smart phone or tablet configured to:receive and to process at least a portion of the output signal, , store and display the processed output signal and transmit at least a portion of the processed output signal over a wireless transmission link.

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receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link.	*See* claim 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Poeze discloses or renders obvious wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 13, 19 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are	Poeze discloses or renders obvious wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 15, 20 above.

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arranged along a second arc that is offset from the first arc.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Poeze discloses or renders obvious wherein the first arc and the second arc are concentric. *See* claim 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D12

U.S. Pat. No. 10,874,304 in view of U.S. Patent No 5,891,022 to Jonas A. Pologe at el.("Pologe")

As described in detail below, Pologe (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D11 and D13-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. . This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Pologe. The cited portions of Pologe are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Pologe. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Pologe "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Pologe does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Pologe (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Pologe anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

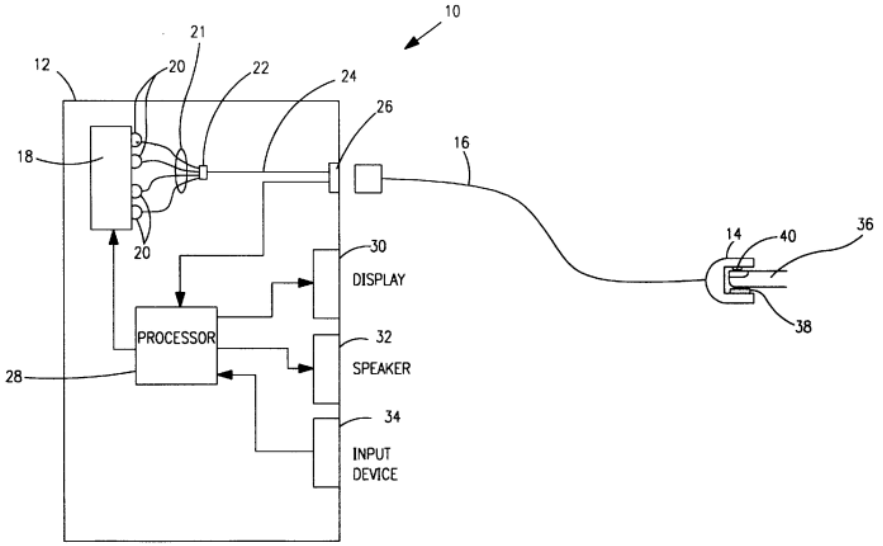
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

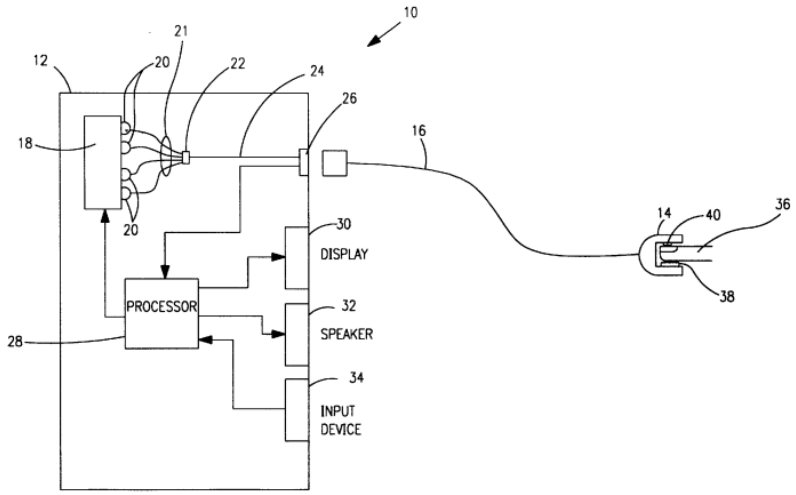
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EXHIBIT D12

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Claim 11	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Pologe discloses or renders obvious a measurement system. In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54

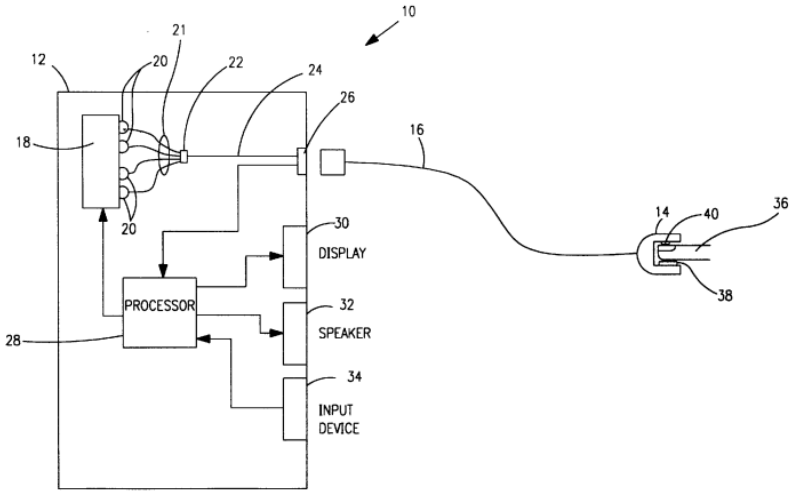
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	 FIG. 1 Pologe at Fig.1. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source	Pologe discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths.

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comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54.  FIG. 1 Tran at Fig. 1.

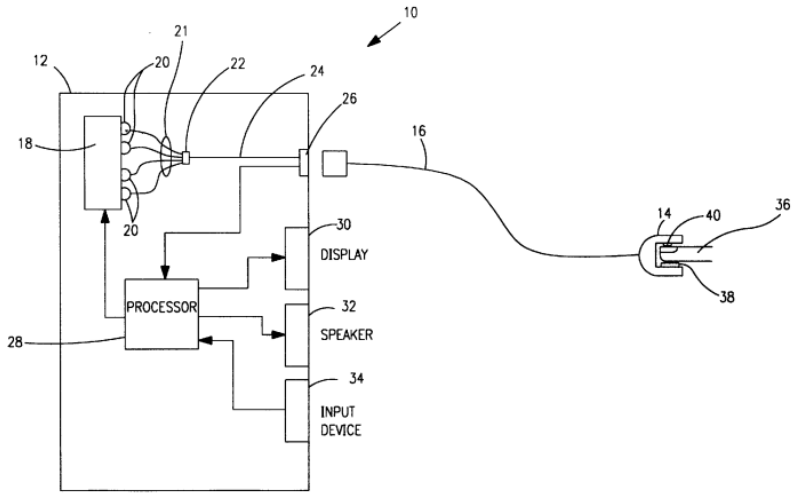
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	The main test unit 12 includes: an emitter module 18 having a plurality of emitters 20, each capable of producing a light signal having a unique spectral content; a plurality of optical cables 21 each coupled to a single emitter source for carrying the corresponding light signal; an optical coupler 22 for coupling light signals from each of the plurality of cables 21 to a single output cable 24; a front panel connector 26 for use in coupling the probe cable 16 to the main test unit 12; a processor unit 28 for performing processing and control functions; a display unit 30 for displaying measurement values to a user; a speaker 32 for providing audible tones to the user; and an input device 34, such as a keypad or a touch screen, for allowing the user to input commands and other information to the processor unit 28. Pologe at 4:63-5:9. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Pologe discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. In another aspect of the present invention, a method is provided for photoplethysmographically measuring one or more arterial blood analytes. The method includes: providing a plurality of separate light signals, each light signal including a spectral content having a unique center frequency; combining the plurality of separate light signals into a single light signal; delivering, after the step of combining, the single light signal to the tissue so that the single light signal is directed into the tissue; detecting a transmitted light signal from the tissue; and processing the transmitted light signal to determine a blood analyte level for the tissue. Pologe at 3:18-28.

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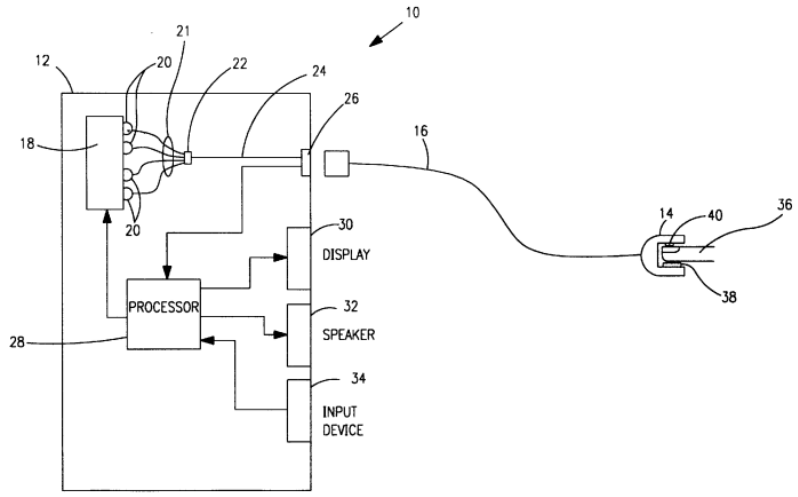
’304 Patent	Pologe
	In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54.  FIG. 1

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	Tran at Fig. 1. Before the light pulses are processed, it is generally required that they be converted to electrical form. This conversion may be performed in the probe, in which case the probe cable includes a thin electrical conductor for carrying the electrical signal back to the main test unit, or it may be performed in the main test unit 12, in which case the light signals are delivered back over the same or a different light transmission line in the probe cable. Pologe at 4:55-62. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Pologe discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the

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	invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54.  FIG. 1 Tran at Fig. 1. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d]. the wearable measurement device further	Pologe discloses or renders obvious the wearable measurement device further comprising a receiver.

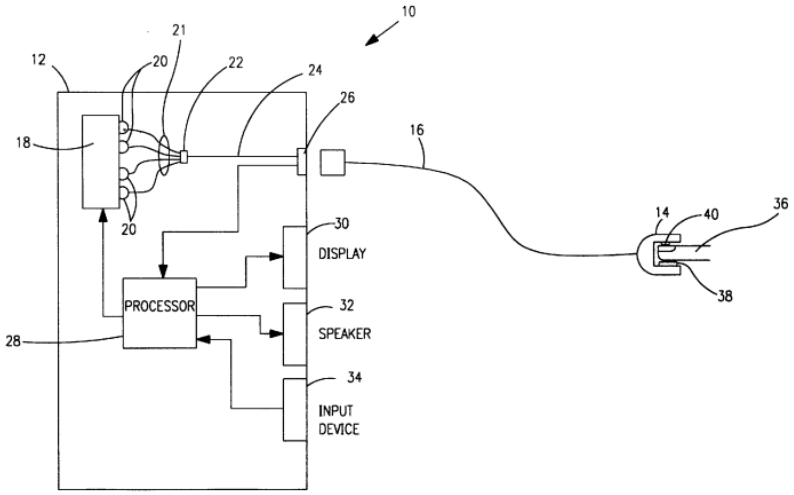
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comprising a receiver configured to:	The plurality of separate emitters includes multiple separate light sources, such as light emitting diodes (LEDs) and laser diodes. In general, the signal delivery means includes a single input/single output light guide such as a single optical fiber, a single fiber bundle, or other type of light guiding means. The single input/single output light guide delivers light to a probe head which couples the light into the tissue under test. The probe head can also include detection means for converting the light signal transmitted through the tissue under test into an electrical signal. In one embodiment, the plurality of emitters and the combining unit are included in a housing, such as a bench top test unit or a handheld unit. The housing may also include means for communicating measurement results to users and means for receiving commands from users. The probe head is physically separated from the housing with the single input/single output light guide connecting them. Pologe at 3:1-17. In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54.

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	 FIG. 1 Tran at Fig. 1. The probe 14 also includes means for receiving the multiplexed light signal after it has been transmitted through the finger 36. In one embodiment, the means for receiving may include a photodetector, such as a pin or avalanche photodiode, for detecting the transmitted light signal and for converting it to an electrical signal. In another embodiment, the means for receiving may include means for coupling the transmitted light signal into the end of a return optical light guide. In one embodiment, this is accomplished by simply holding an end of the return cable against an opposite side of the finger 36. Because the functions performed by the probe 14 are not structurally demanding, the probe 14 can be constructed of a relatively lightweight, inexpensive material, such as plastics or cloth. In addition, because the probe 14 does not include any light sources, it can be relatively small in size, does not necessarily have to include heat shielding, and can potentially be inexpensive to manufacture. Pologe at 7:26-42. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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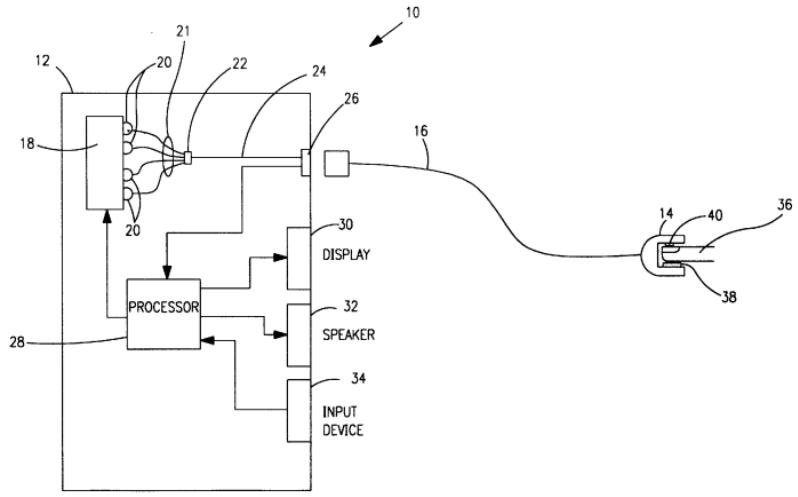
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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample.	Pologe discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. The plurality of separate emitters includes multiple separate light sources, such as light emitting diodes (LEDs) and laser diodes. In general, the signal delivery means includes a single input/single output light guide such as a single optical fiber, a single fiber bundle, or other type of light guiding means. The single input/single output light guide delivers light to a probe head which couples the light into the tissue under test. The probe head can also include detection means for converting the light signal transmitted through the tissue under test into an electrical signal. In one embodiment, the plurality of emitters and the combining unit are included in a housing, such as a bench top test unit or a handheld unit. The housing may also include means for communicating measurement results to users and means for receiving commands from users. The probe head is physically separated from the housing with the single input/single output light guide connecting them. Pologe at 3:1-17. In another aspect of the present invention, a method is provided for photoplethysmographically measuring one or more arterial blood analytes. The method includes: providing a plurality of separate light signals, each light signal including a spectral content having a unique center frequency; combining the plurality of separate light signals into a single light signal; delivering, after the step of combining, the single light signal to the tissue so that the single light signal is directed into the tissue; detecting a transmitted light signal from the tissue; and processing the transmitted light signal to determine a blood analyte level for the tissue. Pologe at 3:18-28.

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	In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54.  FIG. 1 Tran at Fig. 1.

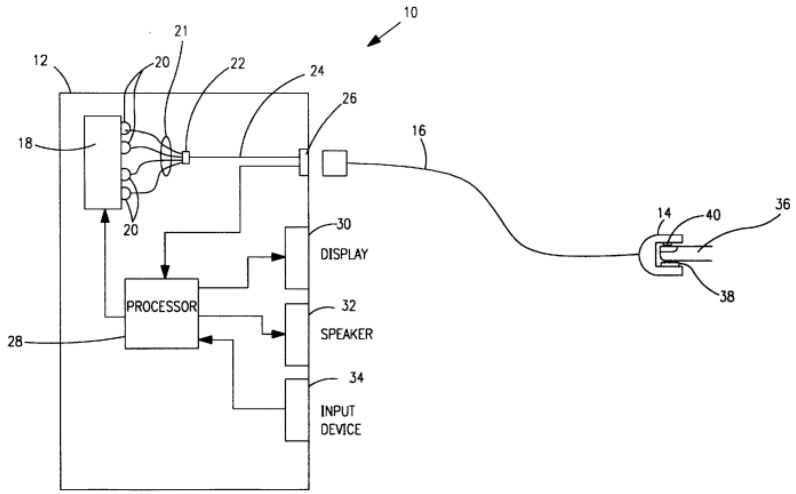
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	The probe 14 also includes means for receiving the multiplexed light signal after it has been transmitted through the finger 36. In one embodiment, the means for receiving may include a photodetector, such as a pin or avalanche photodiode, for detecting the transmitted light signal and for converting it to an electrical signal. In another embodiment, the means for receiving may include means for coupling the transmitted light signal into the end of a return optical light guide. In one embodiment, this is accomplished by simply holding an end of the return cable against an opposite side of the finger 36. Because the functions performed by the probe 14 are not structurally demanding, the probe 14 can be constructed of a relatively lightweight, inexpensive material, such as plastics or cloth. In addition, because the probe 14 does not include any light sources, it can be relatively small in size, does not necessarily have to include heat shielding, and can potentially be inexpensive to manufacture. Pologe at 7:26-42. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Pologe discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. The plurality of separate emitters includes multiple separate light sources, such as light emitting diodes (LEDs) and laser diodes. In general, the signal delivery means includes a single input/single output light guide such as a single optical fiber, a single fiber bundle, or other type of light guiding means. The single input/single output light guide delivers light to a probe head which couples the light into the tissue under test. The probe head can also include detection means for converting the light signal transmitted through the tissue under test into an electrical signal. In one embodiment, the plurality of emitters and the combining unit are included in a housing, such as a bench top test unit or a handheld unit. The housing may also include means for communicating measurement results to users and means for receiving

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	commands from users. The probe head is physically separated from the housing with the single input/single output light guide connecting them. Pologe at 3:1-17. In another aspect of the present invention, a method is provided for photoplethysmographically measuring one or more arterial blood analytes. The method includes: providing a plurality of separate light signals, each light signal including a spectral content having a unique center frequency; combining the plurality of separate light signals into a single light signal; delivering, after the step of combining, the single light signal to the tissue so that the single light signal is directed into the tissue; detecting a transmitted light signal from the tissue; and processing the transmitted light signal to determine a blood analyte level for the tissue. Pologe at 3:18-28. In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54.

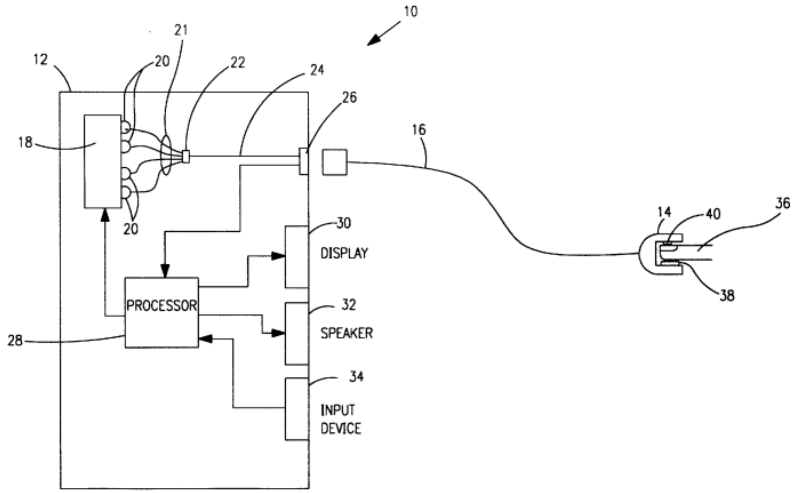
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	 FIG. 1 Tran at Fig. 1. The probe 14 also includes means for receiving the multiplexed light signal after it has been transmitted through the finger 36. In one embodiment, the means for receiving may include a photodetector, such as a pin or avalanche photodiode, for detecting the transmitted light signal and for converting it to an electrical signal. In another embodiment, the means for receiving may include means for coupling the transmitted light signal into the end of a return optical light guide. In one embodiment, this is accomplished by simply holding an end of the return cable against an opposite side of the finger 36. Because the functions performed by the probe 14 are not structurally demanding, the probe 14 can be constructed of a relatively lightweight, inexpensive material, such as plastics or cloth. In addition, because the probe 14 does not include any light sources, it can be relatively small in size, does not necessarily have to include heat shielding, and can potentially be inexpensive to manufacture. Pologe at 7:26-42. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	Pologe discloses or renders obvious the receiver configured to synchronize to the light source. In another aspect of the present invention, a method is provided for photoplethysmographically measuring one or more arterial blood analytes. The method includes: providing a plurality of separate light signals, each light signal including a spectral content having a unique center frequency; combining the plurality of separate light signals into a single light signal; delivering, after the step of combining, the single light signal to the tissue so that the single light signal is directed into the tissue; detecting a transmitted light signal from the tissue; and processing the transmitted light signal to determine a blood analyte level for the tissue. Pologe at 3:18-28. In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54.

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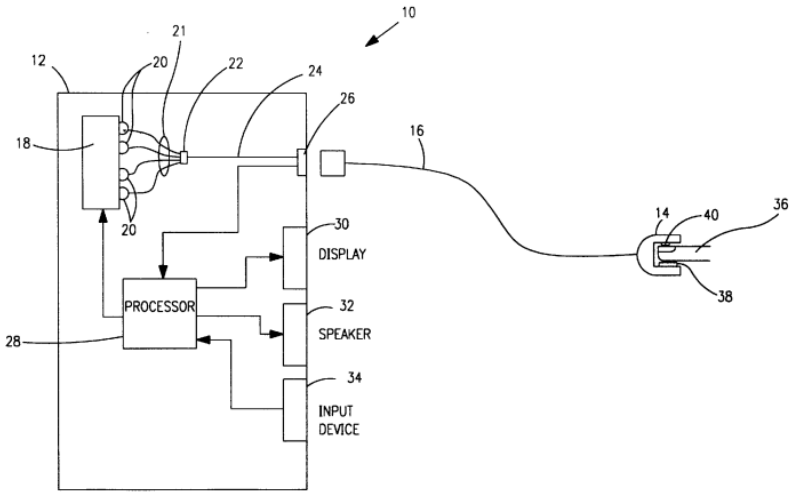
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	 FIG. 1 Tran at Fig. 1. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the captured light into a first signal,	Pologe discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Pologe discloses or renders obvious the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. In another aspect of the present invention, a method is provided for photoplethysmographically measuring one or more arterial blood analytes. The method includes: providing a plurality of separate light signals, each light signal including a spectral content having a unique center frequency; combining the plurality of separate light signals into a single light signal; delivering, after the step of combining, the single light signal to the tissue so that the single light signal is directed into the tissue; detecting a transmitted light signal from the tissue; and processing the transmitted light signal to determine a blood analyte level for the tissue. Pologe at 3:18-28. In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future.

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	Pologe at 4:33-54.  FIG. 1 Tran at Fig. 1. Before the light pulses are processed, it is generally required that they be converted to electrical form. This conversion may be performed in the probe, in which case the probe cable includes a thin electrical conductor for carrying the electrical signal back to the main test unit, or it may be performed in the main test unit 12, in which case the light signals are delivered back over the same or a different light transmission line in the probe cable. Pologe at 4:55-62. The probe 14 also includes means for receiving the multiplexed light signal after it has been transmitted through the finger 36. In one embodiment, the means for receiving may include a photodetector, such as a pin or avalanche photodiode, for detecting the transmitted light signal and for converting it to an electrical signal. In another embodiment, the means for receiving may include means for coupling the transmitted light signal into the end of a return optical light guide. In one embodiment, this is

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	accomplished by simply holding an end of the return cable against an opposite side of the finger 36. Because the functions performed by the probe 14 are not structurally demanding, the probe 14 can be constructed of a relatively lightweight, inexpensive material, such as plastics or cloth. In addition, because the probe 14 does not include any light sources, it can be relatively small in size, does not necessarily have to include heat shielding, and can potentially be inexpensive to manufacture. Pologe at 7:26-42. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Pologe discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. In another aspect of the present invention, a method is provided for photoplethysmographically measuring one or more arterial blood analytes. The method includes: providing a plurality of separate light signals, each light signal including a spectral content having a unique center frequency; combining the plurality of separate light signals into a single light signal; delivering, after the step of combining, the single light signal to the tissue so that the single light signal is directed into the tissue; detecting a transmitted light signal from the tissue; and processing the transmitted light signal to determine a blood analyte level for the tissue. Pologe at 3:18-28. In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a

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	single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54.  FIG. 1 Tran at Fig. 1. Before the light pulses are processed, it is generally required that they be converted to electrical form. This conversion may be performed in the probe, in which case the probe cable includes a thin electrical conductor for carrying the electrical signal back to the main test unit, or it may be performed in the main

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	test unit 12, in which case the light signals are delivered back over the same or a different light transmission line in the probe cable. Pologe at 4:55-62. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	Pologe discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least	Pologe disclose or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.

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a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Pologe discloses or renders obvious wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a]. wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a	Pologe discloses or renders obvious ;wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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comparison with a stored data set; and	incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b]. wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Pologe discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Pologe discloses or renders obvious wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. In another aspect of the present invention, a method is provided for photoplethysmographically measuring one or more arterial blood analytes. The method includes: providing a plurality of separate light signals, each light signal including a spectral content having a unique center frequency; combining the plurality of separate light signals into a single light signal; delivering, after the step of combining, the single light signal to the tissue so that the single light signal is directed into the tissue; detecting a transmitted light signal from the tissue; and processing the transmitted light signal to determine a blood analyte level for the tissue. Pologe at 3:18-28.

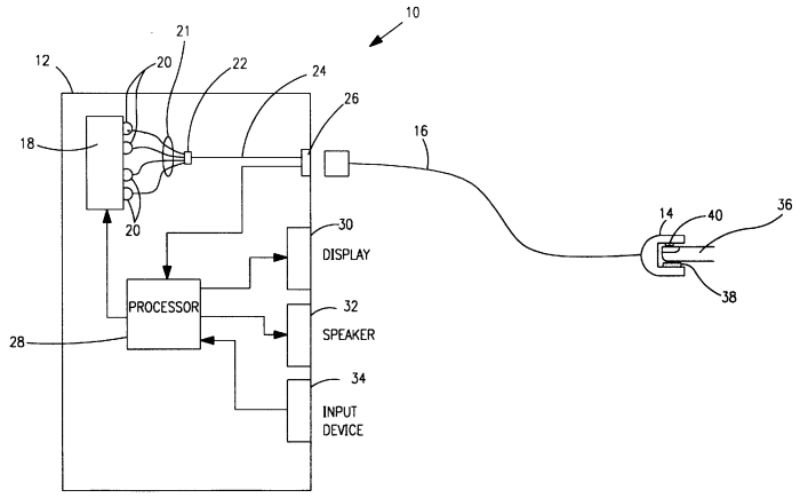
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	In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54. Before the light pulses are processed, it is generally required that they be converted to electrical form. This conversion may be performed in the probe, in which case the probe cable includes a thin electrical conductor for carrying the electrical signal back to the main test unit, or it may be performed in the main test unit 12, in which case the light signals are delivered back over the same or a different light transmission line in the probe cable. Pologe at 4:55-62. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Pologe discloses or renders obviousmeasurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above. In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54.

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’304 Patent	Pologe
	 FIG. 1 Tran at Fig. 1. To perform an oxygen saturation measurement, the processor unit 28 sends a signal to the emitter unit 18 causing the emitters 20 to produce their corresponding light signals. The emitters 20 may include, for example, laser diodes or light emitting diodes (LEDs). In addition, in one embodiment of the invention, the plurality of emitters includes one or more broadband light sources and appropriate filtering means. As used herein, the term "light emitting diode" includes both infrared emitting diodes and ultraviolet emitting diodes. The light signals are combined in the optical coupler 22 into a single multiplexed light signal on output cable 24. Output cable 24 delivers the multiplexed signal to front panel connector 26 from which it is launched onto a single optical light guide within probe cable 16. Probe cable 16 delivers the multiplexed light signal to the probe 14, from which it is directed into the test subject's finger 36. After the multiplexed light signal has been transmitted through the finger 36, it is returned to the main test unit 12 via probe cable 16 in either optical or electrical form. Pologe at [5:16-34]

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Pologe discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Pologe discloses or renders obvious the measurement system of claim 15, wherein the first arc and the second arc are concentric. *See* claim 15 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

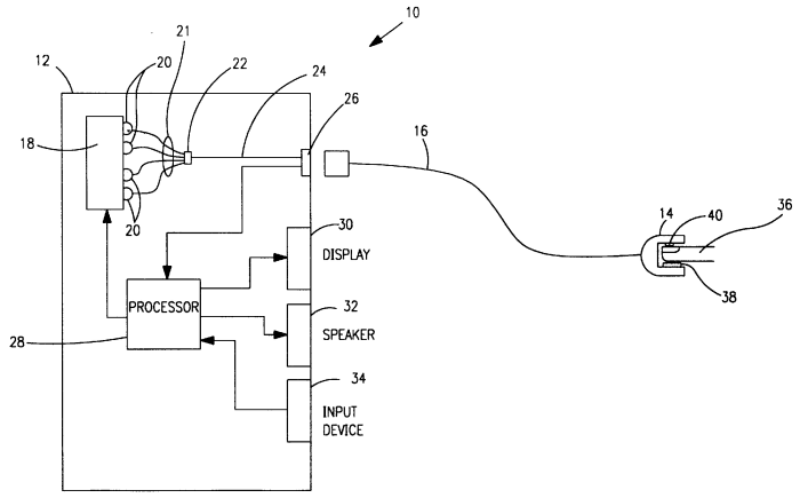
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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Pologe discloses or renders obvious a wearable device for use with a smart phone or tablet. *See* claim 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	Pologe discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* claim 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Pologe discloses or renders obvious the measurement device configured to generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths. In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:33-54.

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	 FIG. 1 Tran at Fig. 1. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Pologe discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* claim 11[c], 11[e], 19[a].

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue	Pologe discloses or renders obvious a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue *See* claim 11[d], 11[h],11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Pologe discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor source. *See* claim 11[a], 11[b], 11[g], 19[a], 19[b], 19[d] . One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Pologe discloses or renders obvious a measurement device configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* claim 11[b], 11[h] 11[i], 11[j], 19[a],19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Pologe discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* claim 11[a], 11[b], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal	Pologe discloses or renders obvious a measurement device configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue.

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representing at least in part a non-invasive measurement on blood contained within the tissue;	*See* claim 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Pologe discloses or renders obvious a measurement device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* claim 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal	Pologe discloses or renders obvious the smart phone or tablet configured to:receive and to process at least a portion of the output signal, store and display the processed output signal. And transmit at least a portion of the processed output signal over a wireless transmission link. *See* claim 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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over a wireless transmission link.	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Pologe discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 13, 19 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Pologe discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Pologe discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claim 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D13

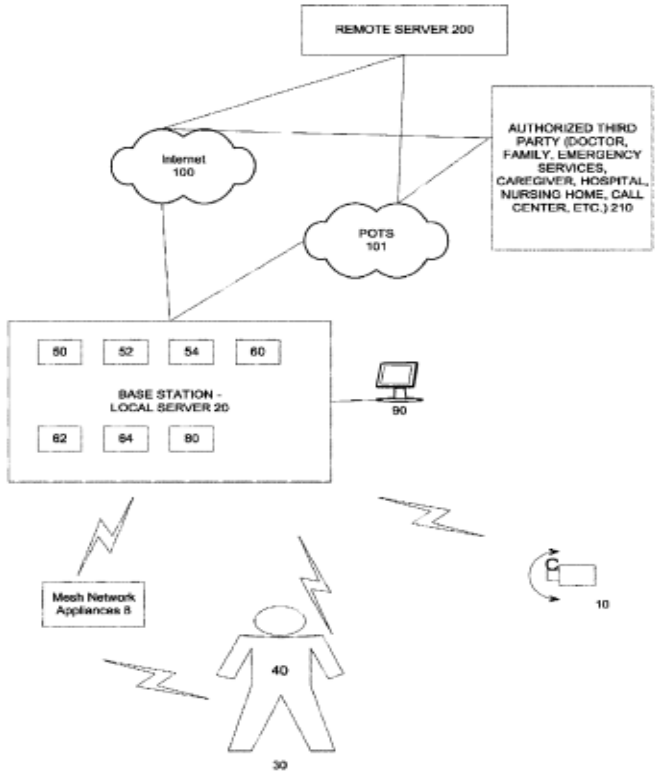
U.S. Pat. No. 10,874,304 in view of U.S. Patent No 8,108,036 to Bao Tran et al. ("Tran")

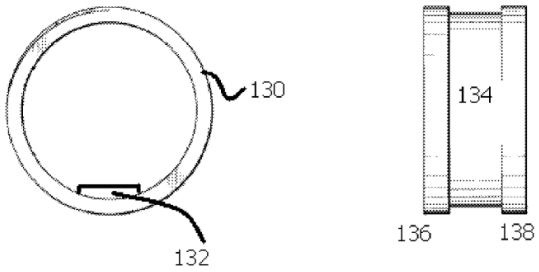
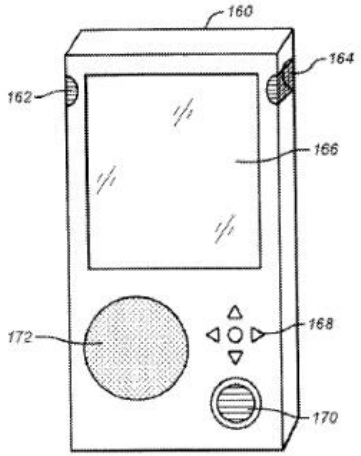
As described in detail below,Tran (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D12 and D14-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Tran. The cited portions of Tran are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Tran. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Tran "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Tran does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Tran (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Tran anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

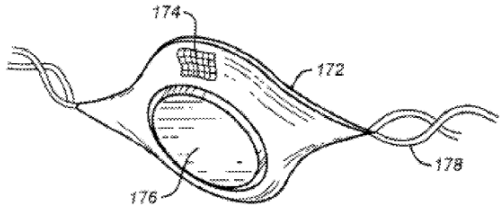
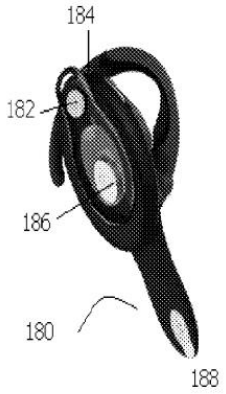
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 11	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Tran discloses or renders obvious a measurement system.  FIG. 1 Tran at Fig.1

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	 FIG. 8 Tran at Fig.8  FIG. 11 Tran at Fig. 11.

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	 FIG. 12 Tran at Fig. 12.  FIG. 13 Tran at Fig. 13. A heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at [Abstract]

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	The invention also minimizes effects of white coat syndrome since the monitor automatically makes measurements with basically no discomfort; measurements are made at the patient’s home or work, rather than in a medical office. The wearable appliance is Small, easily worn by the patient during periods of exercise or day-to-day activities, and non invasively measures blood pressure can be done in a matter of seconds without affecting the patient. An on-board or remote processor can analyze the time-dependent measurements to generate statistics on a patient’s blood pressure (e.g., average pressures, standard deviation, beat-to-beat pressure variations) that are not available with conventional devices that only measure systolic and diastolic blood pressure at isolated times. Tran at 4:58-5:3. FIG. 1 shows an exemplary patient monitoring system. The system can operate in a home, a nursing home, or a hospital. In this system, one or more mesh network appliances 8 are provided to enable wireless communication in the home monitoring system. Appliances 8 in the mesh network can include home security monitoring devices, door alarm, window alarm, home temperature control devices, fire alarm devices, among others. Appliances 8 in the mesh network can be one of multiple portable physiological transducer, such as a blood pressure monitor, heart rate monitor, weight scale, thermometer, spirometer, single or multiple lead electrocardiograph (ECG), a pulse oxymeter, a body fat monitor, a cholesterol monitor, a signal from a medicine cabinet, a signal from a drug container, a signal from a commonly used appliance such as a refrigerator/stove/oven/washer, or a signal from an exercise machine, such as a heart rate. As will be discussed in more detail below, one appliance is a patient monitoring device that can be worn by the patient and includes a single or bi-directional wireless communication link, generally identified by the bolt symbol in FIG. 1, for transmitting data from the appliances 8 to the local hub or receiving station or base station server 20 by way of a wireless radio frequency (RF) link using a proprietary or non-proprietary protocol. For example, within a house, a user may have mesh network appliances that detect window and door contacts, smoke detectors and motion sensors, video cameras, key chain control, temperature monitors, CO and other gas detectors, vibration sensors, and others. A user may have flood sensors and other detectors on a boat. An individual, such as an ill or elderly grandparent, may have access to a panic transmitter or other alarm transmitter. Other sensors and/or detectors may also be included. The user may register these appliances on a central security network by entering the identification code for each registered appliance/device and/or system.

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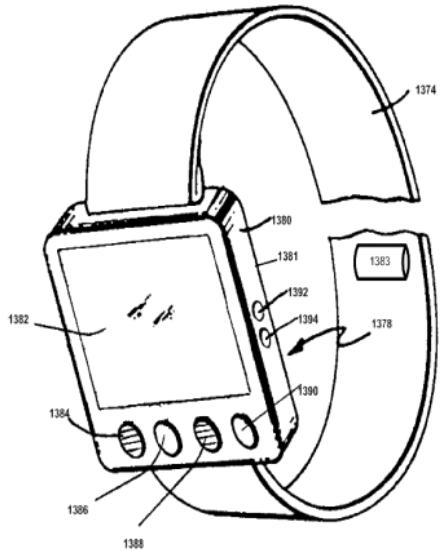
’304 Patent	Tran
	The mesh network can be Zigbee network or 802.15 network. More details of the mesh network is shown in FIG. 7 and discussed in more detail below. Tran at 8:29-65 The wearable appliance is small, easily worn by the patient during periods of exercise or day-to-day activities, and non invasively measures blood pressure can be done in a matter of seconds without affecting the patient. An on-board or remote processor can analyze the time-dependent measurements to generate statistics on a patient’s blood pressure (e.g., average pressures, standard deviation, beat-to-beat pressure variations) that are not available with conventional devices that only measure systolic and diastolic blood pressure at isolated times. Tran at 25:19-29 The base station 20 frequently collects and synchronizes data from the appliances 8. The base station 20 may use one of various transportation methods to connect to the repository on the server 200 using a PC as conduit or through a connection established using an embedded modem (connected to a phone line), a wireless router (DSL or cable wireless router), a cellular modem, or another network-connected appliance (such as, but not limited to, a web-phone, video-phone, embedded computer, PDA or handheld computer). Tran at 27:9-17 In another optical embodiment, blood pressure is estimated from the optical reading using a mathematical model such as a linear correlation with a known blood pressure reading. In this embodiment, the pulse oximeter readings are compared to the blood-pressure readings from a known working blood pressure measurement device during calibration. Tran at 61:6-11. Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to

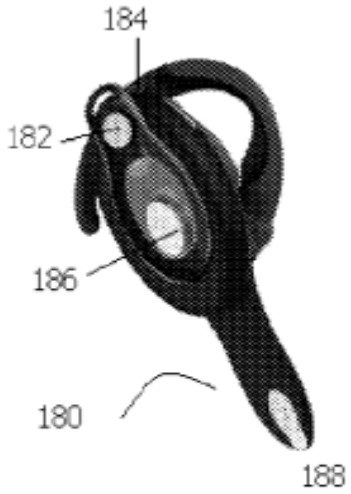
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	receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. Tran at 67:28-48 FIGS. 11 and 12 show two additional embodiments of the monitoring device. In FIG. 11, a wearable monitoring device is shown. The monitoring device has a body 160 comprising microphone ports 162, 164 and 170 arranged in a first order noise cancelling microphone arrangement. The microphones 162 and 164 are configured to optimally receive distant noises, while the microphone 170 is optimized for capturing the user's speech. A touch sensitive display 166 and a plurality of keys 168 are provided to capture hand inputs. Further, a speaker 172 is provided to generate a verbal feedback to the user. Tran at 68:3-13. Turning now to FIG. 12, a jewelry-sized monitoring device is illustrated. In this embodiment, a body 172 houses a microphone port 174 and a speaker port 176. The body 172 is coupled to the user via the necklace 178 so as to provide a personal, highly accessible personal computer. Due to space limitations, voice input/output is an important user interface of the jewelry-sized computer. Although a necklace is disclosed, one skilled in the art can use a number of other substitutes such as a belt, a brace, a ring, or a band to secure the jewelry-sized computer to the user. Tran at 68:14-23 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module

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	186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Tran discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths.

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	 FIG. 6A Tran at Fig. 6a

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	 FIG. 13 Tran at Fig. 13 A heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at Abstract. In another aspect, heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at 3:6-13.

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	The patient 30 may wear one or more wearable patient monitoring appliances such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance such as a wrist-watch includes sensors 40, for example devices for sensing ECG, EKG, blood pressure, sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient's wrist (such as a wristwatch sensor) and other convenient anatomical locations. Exemplary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascular system (ECG). Leg sensors can include piezoelectric accelerometers designed to give qualitative assessment of limb movement. Additionally, thoracic and abdominal bands used to measure expansion and contraction of the thorax and abdomen respectively. A small sensor can be mounted on the subject's finger in order to detect blood-oxygen levels and pulse rate. Additionally, a microphone can be attached to throat and used in sleep diagnostic recordings for detecting breathing and other noise. One or more position sensors can be used for detecting orientation of body (lying on left side, right side or back) during sleep diagnostic recordings. Each of sensors 40 can individually transmit data to the server 20 using wired or wireless transmission. Alternatively, all sensors 40 can be fed through a common bus into a single transceiver for wired or wireless transmission. The transmission can be done using a magnetic medium such as a floppy disk or a flash memory card, or can be done using infrared or radio network link, among others. The sensor 40 can also include an indoor positioning system or alternatively a global position system (GPS) receiver that relays the position and ambulatory patterns of the patient to the server 20 for mobility tracking. Tran at 9:23-54 The wearable appliance is small, easily worn by the patient during periods of exercise or day-to-day activities, and non invasively measures blood pressure can be done in a matter of seconds without affecting the patient. An on-board or remote processor can analyze the time-dependent measurements to generate statistics on a patient’s blood pressure (e.g., average pressures, standard deviation, beat-to-beat pressure variations) that are not available with conventional devices that only measure systolic and diastolic blood pressure at isolated times. Tran at 25:19-29. In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be

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	light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. In an embodiment to be worn on the patient's ear lobe, the monitoring device can be part of an earring jewelry clipped to the ear lobe. In the implementation of FIG. 10, the monitoring device has a jewelry body 149 that contains the monitoring electronics and power source. The surface of the body 149 is an ornamental surface such as jade, ivory, pearl, silver, or gold, among others. The body 149 has an opening 148 that transmits energy such as optical or acoustic energy through the ear lobe to be detected by a sensor 144 mounted on a clamp portion that is secured to the body 149 at a base 147. The energy detected through the sensor 144 is communicated through an electrical connector to the electronics in

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	the jewelry body 149 for processing the received energy and for performing wireless communication with a base station. In FIG. 2E, a bolt 145 having a stop end 146 allows the user to adjust the pressure of the clamp against the ear lobe. In other implementations, a spring biased clip is employed to retain the clip on the wearer's ear lobe. A pair of members, which snap together under pressure, are commonly used and the spring pressure employed should be strong enough to suit different thicknesses of the ear lobe. FIGS. 11 and 12 show two additional embodiments of the monitoring device. In FIG. 11, a wearable monitoring device is shown. The monitoring device has a body 160 comprising microphone ports 162, 164 and 170 arranged in a first order noise cancelling microphone arrangement. The microphones 162 and 164 are configured to optimally receive distant noises, while the microphone 170 is optimized for capturing the user's speech. A touch sensitive display 166 and a plurality of keys 168 are provided to capture hand inputs. Further, a speaker 172 is provided to generate a verbal feedback to the user. Turning now to FIG. 12, a jewelry-sized monitoring device is illustrated. In this embodiment, a body 172 houses a microphone port 174 and a speaker port 176. The body 172 is coupled to the user via the necklace 178 so as to provide a personal, highly accessible personal computer. Due to space limitations, voice input/output is an important user interface of the jewelry-sized computer. Although a necklace is disclosed, one skilled in the art can use a number of other substitutes such as a belt, a brace, a ring, or a band to secure the jewelry-sized computer to the user. FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 67:28-68:38

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Tran discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. In one embodiment, the back of the device is a conductive metal electrode 1381 that in conjunction with a second electrode 1383 mounted on the wrist band 1374, enables differential EKG or ECG to be measured. The electrical signal derived from the electrodes is typically 1 mV peak-peak. In one embodiment where only one electrode 1381 or 1383 is available, an amplification of about 1000 is necessary to render this signal usable for heart rate detection. In the embodiment with electrodes 1381 and 1383 available, a differential amplifier is used to take advantage of the identical common mode signals from the EKG contact points, the common mode noise is automatically cancelled out using a matched differential amplifier. In one embodiment, the differential amplifier is a Texas Instruments INA321 instrumentation amplifier that has matched and balanced integrated gain resistors. This device is specified to operate with a minimum of 2.7V single rail power supply. The INA321 provides a fixed amplification of 5× for the EKG signal. With its CMRR specification of 94 dB extended up to 3 KHz the INA321 rejects the common mode noise signals including the line frequency and its harmonics. The quiescent current of the INA321 is 40 mA and the shut down mode current is less than 1 mA. The amplified EKG signal is internally fed to the on chip analog to digital converter. The ADC samples the EKG signal with a sampling frequency of 512 Hz. Precise sampling period is achieved by triggering the ADC conversions with a timer that is clocked from a 32.768 kHz low frequency crystal oscillator. The sampled EKG waveform contains some amount of super imposed line frequency content. This line frequency noise is removed by digitally filtering the samples. In one implementation, a 17-tap low pass FIR filter with pass band upper frequency of 6 Hz and stop band lower frequency of 30 Hz is implemented in this application. The filter coefficients are scaled to compensate the filter attenuation and provide additional gain for the EKG signal at the filter output. This adds up to a total amplification factor of greater than 1000× for the EKG signal.

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	Tran at 34:53-35:22 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12. In the electromagnetic sensor embodiment, the wrist band 1374 is a flexible plastic material incorporated with a flexible magnet. The magnet provides a magnetic field, and one or more electrodes similar to electrode 1383 are positioned on the wrist band to measure voltage drops which are proportional to the blood velocity. The electromagnetic embodiment may be mounted on the upper arm of the patient, on the ankle or on the neck where peripheral blood vessels pass through and their blood velocity may be measured with minimal interruptions. The flexible magnet produces a pseudo-uniform (non-gradient) magnetic field. The magnetic field can be normal to the blood flow direction when wrist band 1374 is mounted on the user's wrist or may be a rotative pseudo-uniform magnetic field so that the magnetic field is in a transversal direction in respect to the blood flow direction. The electrode output signals are processed to obtain a differential measurement enhancing the signal to noise ratio. The flow information is derived based on the periodicity of the signals. The decoded signal is filtered over several periods and then analyzed for changes used to estimate artery and vein blood flow. Systemic stroke volume and cardiac output may be calculated from the peripheral SV index value. Tran at 37:13-34

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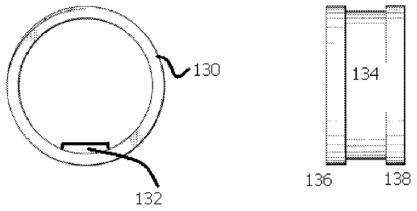
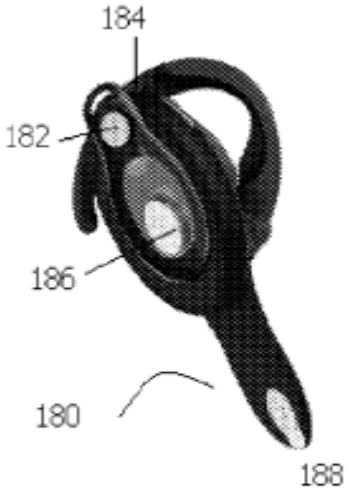
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	In one EKG or ECG detector, the heartbeat detection circuitry includes a differential amplifier for amplifying the signal transmitted from the EKG/ECG electrodes and for converting it into single-ended form, and a bandpass filter and a 60 Hz notch filter for removing background noise. The CPU measures the time durations between the successive pulses and estimates the heartbeat rate. The time durations between the successive pulses of the pulse sequence signal provides an estimate of heartbeat rate. Each time duration measurement is first converted to a corresponding rate, preferably expressed in beats per minute (bpm), and then stored in a file, taking the place of the earliest measurement previously stored. After a new measurement is entered into the file, the stored measurements are averaged, to produce an average rate measurement. The CPU optionally determines which of the stored measurements differs most from the average, and replaces that measurement with the average. Tran at 60:27-43 In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or earlobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implement tation, a reflective sensor such as the Honeywell HLC1395 can be used. The device emits lights from a window in the infrared spectrum and receives reflected light in a second window. When the heartbeats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, andthe resulting optical waveform is captured by the CPU. Tran at 60:58-61:5. In one embodiment of the feature extractor, the digitized heart sound signal series s(n) is put through a low-order filter, typically a first-order finite impulse response filter, to spectrally flatten the signal and to make the signal less susceptible to finite precision effects encountered later in the signal processing. The signal is pre-emphasized preferably using a fixed pre-emphasis network, or preemphasizer. The signal can also be passed through a slowly adaptive pre-emphasizer. The preemphasized heart sound signal is next presented to a frame blocker to be blocked into frames of N samples with adjacent frames being separated by M samples. In one implementation, frame 1 contains the first 400 samples. The frame 2 also contains 400 samples, but begins at the 300th sample and continues until the 700th sample. Because the adjacent frames overlap, the resulting LPC spectral analysis will be correlated from frame

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	to frame. Each frame is windowed to minimize signal discontinuities at the beginning and end of each frame. The windower tapers the signal to zero at the beginning and end of each frame. Preferably, the window used for the autocorrelation method of LPC is the Hamming window. A noise canceller operates in conjunction with the autocorrelator to minimize noise. Noise in the heart sound pattern is estimated during quiet periods, and the temporally stationary noise sources are damped by means of spectral subtraction, where the autocorrelation of a clean heart sound signal is obtained by subtracting the autocorrelation of noise from that of corrupted heart sound. In the noise cancellation unit, if the energy of the current frame exceeds a reference threshold level, the heart is generating sound and the autocorrelation of coefficients representing noise is not updated. However, if the energy of the current frame is below the reference threshold level, the effect of noise on the correlation coefficients is subtracted off in the spectral domain. The result is half-wave rectified with proper threshold setting and then converted to the desired autocorrelation coefficients. Tran at 76:54-77:21. The interval between each successive pair of same direction, either positive or negative going, crossings of each predetermined sound intensity level is determined and a count of the inverse of these interspike intervals of the multilevel detectors for each spectral portion is stored as a function of frequency. The resulting histogram of the ensemble of inverse interspike intervals forms a spectral pattern that is representative of the spectral distribution of the auditory neural response to the input sound and is relatively insensitive to noise The use of a plurality of logarithmically related sound intensity levels accounts for the intensity of the input signal in a particular frequency range. Thus, a signal of a particular frequency having high intensity peaks results in a much larger count for that frequency than a low intensity signal of the same frequency. The multiple level histograms of the type described herein readily indicate the intensity levels of the nerve firing spectral distribution and cancel noise effects in the individual intensity level histograms. Alternatively, the fractal parameter block can further be used alone or in conjunction with others to represent spectral information. Fractals have the property of self similarity as the spatial scale is changed over many orders of magnitude. A fractal function includes both the basic form inherent in a shape and the statistical or random properties of the replacement of that shape in space. As is known in the art, a fractal generator employs mathematical operations known as local affine transformations. These transformations are employed in the process of encoding digital data representing spectral data. The encoded output constitutes a “fractal transform” of the spectral data and consists of coefficients of the affine transformations. Different fractal transforms correspond to different images or sounds.

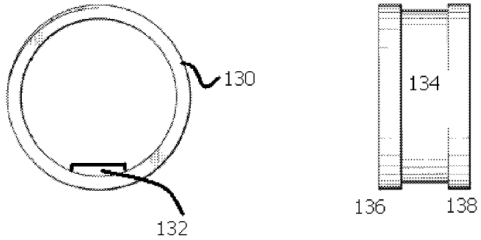
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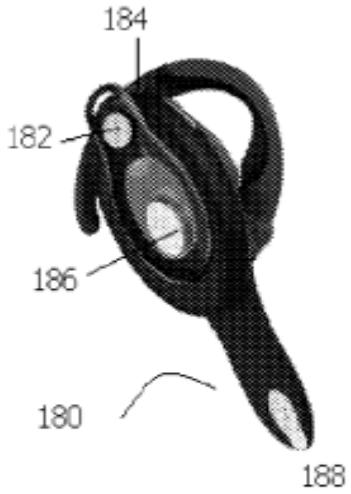
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	Tran at 77:67-78:31. As shown in FIG. 17A, to eliminate the potentially much greater noise signal from power line sources, a differential instrumentation amplifier is employed. Any signal that originates far away from the detection sites will appear as a common signal, whereas signals in the immediate vicinity of the detection surfaces will be different and consequently will be amplified. Thus, relatively distant power lines noise signals will be removed and relatively local EMG signals will be amplified. The source impedance at the junction of the skin and detection surface may range from several thousand ohms to several megohms for dry skin. In order to prevent attenuation and distortion of the detected signal due to the effects of input loading, the input impedance of the differential amplifier is as large as possible, without causing ancillary complications to the workings of the differential amplifier. The signal to noise ratio is increased by filtering between 20-500 Hz with a roll-off of 12 dB/octave. Tran at 91:12-28. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Tran discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample.

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	 FIG. 8 Tran at Fig. 8  FIG. 13 Tran at Fig. 13 In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat

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	amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implementation, a reflective sensor such as the Honeywell HLC1395 can be used. The device emits lights from a window in the infrared spectrum and receives reflected light in a second window. When the heart beats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, and the resulting optical waveform is captured by the CPU. Tran at 60:58-61:5 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38

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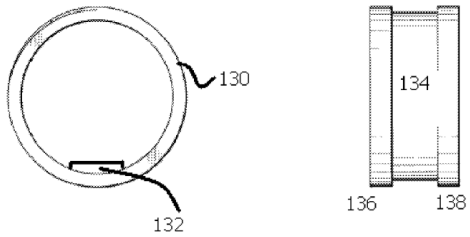
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11[d]. the wearable measurement device further comprising a receiver configured to:	Tran discloses or renders obvious the wearable measurement device further comprising a receiver.  FIG. 8 Tran at Fig. 8

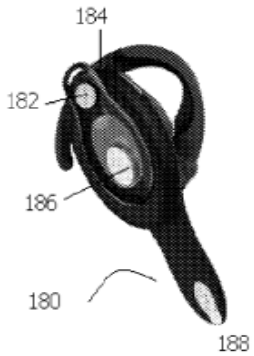
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	 FIG. 13 Tran at Fig. 13 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12

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	In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implementation, a reflective sensor such as the Honeywell HLC1395 can be used. The device emits lights from a window in the infrared spectrum and receives reflected light in a second window. When the heart beats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, and the resulting optical waveform is captured by the CPU. Tran at 60:58-61:5 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. Tran at 67:28-48 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such

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	as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample	Tran discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample.  FIG. 8 Tran at Fig. 8

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	 FIG. 13 Tran at Fig. 13 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implementation, a reflective sensor such as the Honeywell HLC1395 can be used. The device emits lights from a window in the infrared spectrum and receives

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	reflected light in a second window. When the heart beats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, and the resulting optical waveform is captured by the CPU. Tran at 60:58-61:5 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. Tran at 67:28-48 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human.

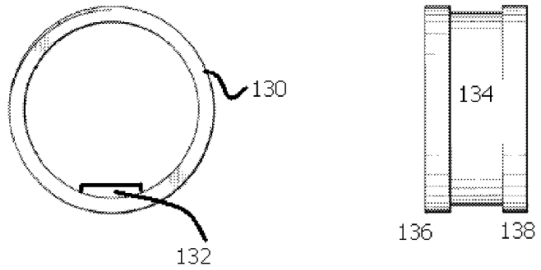
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	Tran at 68:24-38 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Tran discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implementation, a reflective sensor such as the Honeywell HLC1395 can be used. The device emits lights from a window in the infrared spectrum and receives reflected light in a second window. When the heart beats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light

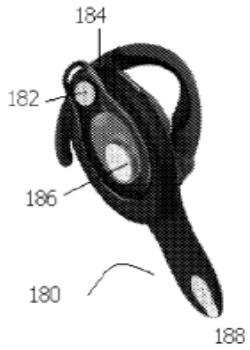
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	can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, and the resulting optical waveform is captured by the CPU. Tran at 60:58-61:5 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. Tran at 67:28-48 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38

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11[g]. synchronize to the light source,	Tran discloses or renders obvious the receiver configured to synchronize to the light source.  FIG. 8 Tran at Fig. 8

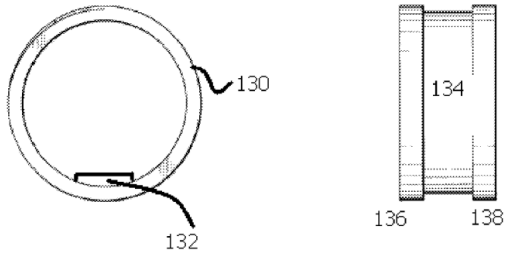
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	 FIG. 13 Tran at Fig. 13 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation,

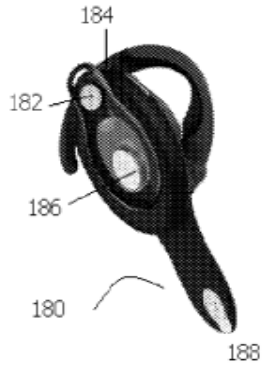
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	the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40. FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the captured light into a first signal,	Tran discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would

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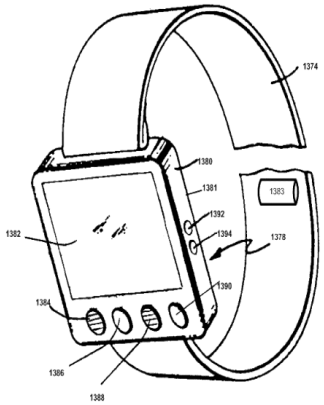
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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Tran discloses or renders obvious the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample.  FIG. 8 Tran at Fig. 8

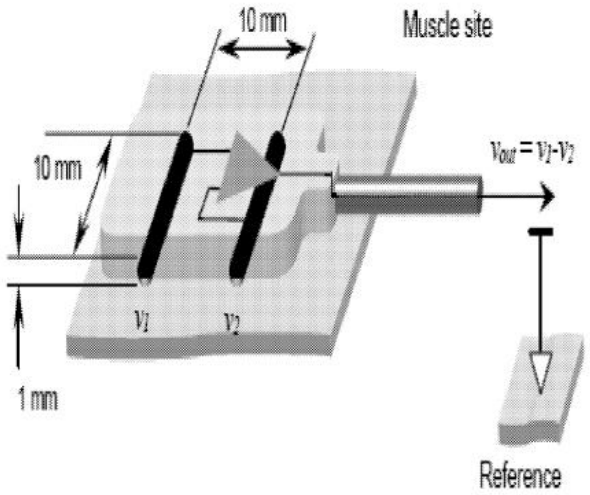
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	 FIG. 13 Tran at Fig. 13 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implementation, a reflective sensor such as the Honeywell

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	HLC1395 can be used. The device emits lights from a window in the infrared spectrum and receives reflected light in a second window. When the heart beats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, and the resulting optical waveform is captured by the CPU. Tran at 60:58-61:5 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Tran discloses or renders obvious the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal.  FIG. 6A Tran at Fig. 6a.

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	 FIG. 17A Tran at Fig. 17a. In one embodiment, the back of the device is a conductive metal electrode 1381 that in conjunction with a second electrode 1383 mounted on the wrist band 1374, enables differential EKG or ECG to be measured. The electrical signal derived from the electrodes is typically 1 mV peak-peak. In one embodiment where only one electrode 1381 or 1383 is available, an amplification of about 1000 is necessary to render this signal usable for heart rate detection. In the embodiment with electrodes 1381 and 1383 available, a differential amplifier is used to take advantage of the identical common mode signals from the EKG contact points, the common mode noise is automatically cancelled out using a matched differential amplifier. In one embodiment, the differential amplifier is a Texas Instruments INA321 instrumentation amplifier that has matched and balanced integrated gain resistors. This device is specified to operate with a minimum of 2.7V single rail power supply. The INA321 provides a fixed amplification of 5× for the EKG signal. With its CMRR specification of 94 dB extended up to 3 KHz the INA321 rejects the common mode noise signals including the line frequency and its harmonics. The quiescent current of the INA321 is 40 mA and the shut down mode current is less than 1 mA. The amplified EKG signal is internally fed to the on chip analog to digital converter. The ADC samples the EKG signal with a sampling frequency of 512 Hz. Precise sampling period is achieved by triggering the ADC conversions with a timer that is clocked from a 32.768 kHz low frequency crystal oscillator. The

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	sampled EKG waveform contains some amount of super imposed line frequency content. This line frequency noise is removed by digitally filtering the samples. In one implementation, a 17-tap low pass FIR filter with pass band upper frequency of 6 Hz and stop band lower frequency of 30 Hz is implemented in this application. The filter coefficients are scaled to compensate the filter attenuation and provide additional gain for the EKG signal at the filter output. This adds up to a total amplification factor of greater than 1000× for the EKG signal. Tran at 34:53-35:22. In the electromagnetic sensor embodiment, the wrist band 1374 is a flexible plastic material incorporated with a flexible magnet. The magnet provides a magnetic field, and one or more electrodes similar to electrode 1383 are positioned on the wrist band to measure voltage drops which are proportional to the blood velocity. The electromagnetic embodiment may be mounted on the upper arm of the patient, on the ankle or on the neck where peripheral blood vessels pass through and their blood velocity may be measured with minimal interruptions. The flexible magnet produces a pseudo-uniform (non-gradient) magnetic field. The magnetic field can be normal to the blood flow direction when wrist band 1374 is mounted on the user's wrist or may be a rotative pseudo-uniform magnetic field so that the magnetic field is in a transversal direction in respect to the blood flow direction. The electrode output signals are processed to obtain a differential measurement enhancing the signal to noise ratio. The flow information is derived based on the periodicity of the signals. The decoded signal is filtered over several periods and then analyzed for changes used to estimate artery and vein blood flow. Systemic stroke volume and cardiac output may be calculated from the peripheral SV index value. Tran at 37:13-34 In one EKG or ECG detector, the heartbeat detection circuitry includes a differential amplifier for amplifying the signal transmitted from the EKG/ECG electrodes and for converting it into single-ended form, and a bandpass filter and a 60 Hz notch filter for removing background noise. The CPU measures the time durations between the successive pulses and estimates the heartbeat rate. The time durations between the successive pulses of the pulse sequence signal provides an estimate of heartbeat rate. Each time duration measurement is first converted to a corresponding rate, preferably expressed in beats per minute (bpm), and then stored in a file, taking the place of the earliest measurement previously stored. After a new measurement is entered into the file, the stored measurements are averaged, to produce an

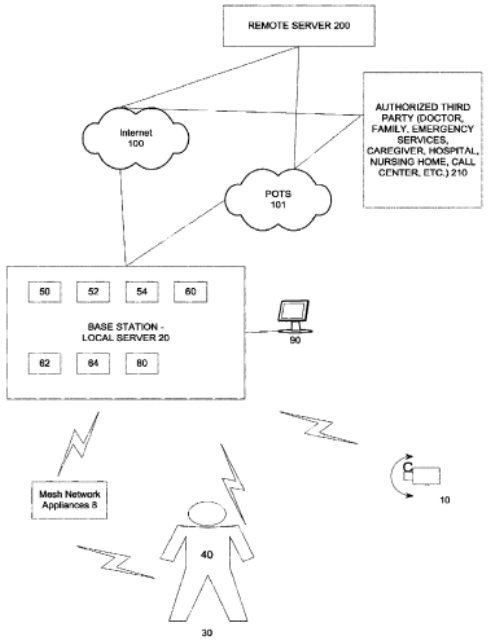
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	average rate measurement. The CPU optionally determines which of the stored measurements differs most from the average, and replaces that measurement with the average. Tran at 60:27-43 In one embodiment of the feature extractor, the digitized heart sound signal series s(n) is put through a low-order filter, typically a first-order finite impulse response filter, to spectrally flatten the signal and to make the signal less susceptible to finite precision effects encountered later in the signal processing. The signal is pre-emphasized preferably using a fixed pre-emphasis network, or preemphasizer. The signal can also be passed through a slowly adaptive pre-emphasizer. The preemphasized heart sound signal is next presented to a frame blocker to be blocked into frames of N samples with adjacent frames being separated by M samples. In one implementation, frame 1 contains the first 400 samples. The frame 2 also contains 400 samples, but begins at the 300th sample and continues until the 700th sample. Because the adjacent frames overlap, the resulting LPC spectral analysis will be correlated from frame to frame. Each frame is windowed to minimize signal discontinuities at the beginning and end of each frame. The windower tapers the signal to zero at the beginning and end of each frame. Preferably, the window used for the autocorrelation method of LPC is the Hamming window. A noise canceller operates in conjunction with the autocorrelator to minimize noise. Noise in the heart sound pattern is estimated during quiet periods, and the temporally stationary noise sources are damped by means of spectral subtraction, where the autocorrelation of a clean heart sound signal is obtained by subtracting the autocorrelation of noise from that of corrupted heart sound. In the noise cancellation unit, if the energy of the current frame exceeds a reference threshold level, the heart is generating sound and the autocorrelation of coefficients representing noise is not updated. However, if the energy of the current frame is below the reference threshold level, the effect of noise on the correlation coefficients is subtracted off in the spectral domain. The result is half-wave rectified with proper threshold setting and then converted to the desired autocorrelation coefficients. Tran at 76:54-77:21. As shown in FIG. 17A, to eliminate the potentially much greater noise signal from power line sources, a differential instrumentation amplifier is employed. Any signal that originates far away from the detection sites will appear as a common signal, whereas signals in the immediate vicinity of the detection surfaces will be different and consequently will be amplified. Thus, relatively distant power lines noise signals will be removed and relatively local EMG signals will be amplified. The source impedance at the junction

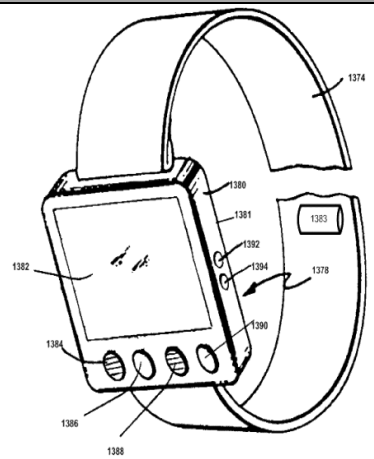
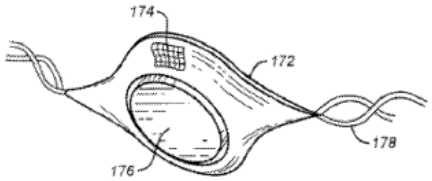
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	of the skin and detection surface may range from several thousand ohms to several megohms for dry skin. In order to prevent attenuation and distortion of the detected signal due to the effects of input loading, the input impedance of the differential amplifier is as large as possible, without causing ancillary complications to the workings of the differential amplifier. The signal to noise ratio is increased by filtering between 20-500 Hz with a roll-off of 12 dB/octave. Tran at 91:12-28 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	Tran discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link.

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	 FIG. 1 Tran at Fig. 1.

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	 FIG. 6A Tran at Fig. 6a.  FIG. 12 Tran at Fig. 12. In another aspect, heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at 3:6-13

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	In yet another embodiment, a wireless housing provides one or more bioelectric contacts conveniently positioned to collect bioelectric patient data. The housing can be a patch, a wristwatch, a band, a wristband, a chest band, a leg band, a sock, a glove, a foot pad, a head-band, an ear-clip, an ear phone, a shower-cap, an armband, an ear-ring, eye-glasses, sun-glasses, a belt, a sock, a shirt, a garment, a jewelry, a bed spread, a pillow cover, a pillow, a mattress, a blanket or a sleeping garment such as a pajama. The bed spread, pillow cover, pillow, mattress, blanket or pajama can have bioelectrically conductive contacts in an array so that the patient can enjoy his/her sleep while vital parameters can be captured. In one embodiment, an array of parallel conductive lines can be formed on the housing side that faces the patient and the electrical signal can be picked up. The data captured by the contacts are transmitted over the mesh network such as ZigBee to a base station. In the above embodiments, the base station can perform the bioelectric signal processing to extract patient parameters from data captured by the contacts. In this case, the base station may need a DSP or powerful CPU to perform the calculations. Alternatively, in an ASP model, the base station can simply compress the data and upload the data to a central server or server farm for processing and the result of the signal processing are sent back to the base station for relay to the patient interface which can be a wrist-watch, a pad, or a band, among others, for notification of any warning signs. Tran at 7:31-57. The base station/server 20 stores the patient's ambulation pattern and vital parameters and can be accessed by the patient's family members (sons/daughters), physicians, caretakers, nurses, hospitals, and elderly community. The base station/server 20 may communicate with the remote server 200 by DSL, T-1 connection over a private communication network or a public information network, such as the Internet 100, among others. Tran at 9:15-22. The patient 30 may wear one or more wearable patient monitoring appliances such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance such as a wrist-watch includes sensors 40, for example devices for sensing ECG, EKG, blood pressure, sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient's wrist (such as a wristwatch sensor) and other convenient anatomical locations. Exemplary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain

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	(EEG) and cardiovascular system (ECG). Leg sensors can include piezoelectric accelerometers designed to give qualitative assessment of limb movement. Additionally, thoracic and abdominal bands used to measure expansion and contraction of the thorax and abdomen respectively. A small sensor can be mounted on the subject's finger in order to detect blood-oxygen levels and pulse rate. Additionally, a microphone can be attached to throat and used in sleep diagnostic recordings for detecting breathing and other noise. One or more position sensors can be used for detecting orientation of body (lying on left side, right side or back) during sleep diagnostic recordings. Each of sensors 40 can individually transmit data to the server 20 using wired or wireless transmission. Alternatively, all sensors 40 can be fed through a common bus into a single transceiver for wired or wireless transmission. The transmission can be done using a magnetic medium such as a floppy disk or a flash memory card, or can be done using infrared or radio network link, among others. The sensor 40 can also include an indoor positioning system or alternatively a global position system (GPS) receiver that relays the position and ambulatory patterns of the patient to the server 20 for mobility tracking. Tran at 9:23-54. The base station 20 frequently collects and synchronizes data from the appliances 8. The base station 20 may use one of various transportation methods to connect to the repository on the server 200 using a PC as conduit or through a connection established using an embedded modem (connected to a phone line), a wireless router (DSL or cable wireless router), a cellular modem, or another network-connected appliance (such as, but not limited to, a web-phone, video-phone, embedded computer, PDA or handheld computer). Tran at 27:9-17. The system can also determine vital parameter including patient heart rate (1006). The system determines if patient needs assistance based on in door position, fall detection and vital parameter (1008). If a fall is suspected, the system confirms the fall by communicating with the patient prior to calling a third party such as the patient’s physician, nurse, family member, 911, 511, 411, or a paid call center to get assistance for the patient (1010). If confirmed or if the patient is non-responsive, the system contacts the third party and sends Voice over mesh network to appliance on the patient to allow one or more third parties to talk with the patient (1012). If needed, the system calls and/or conferences emergency personnel into the call (1014).

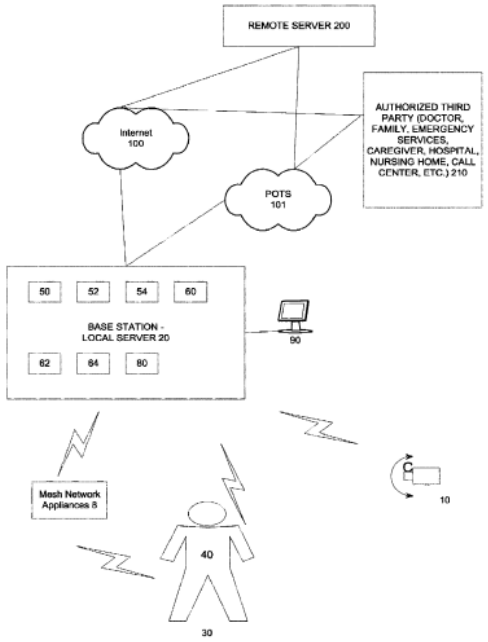
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	In one embodiment, if the patient is outside of the mesh network range such as when the user is traveling away from his/her home, the system continuously records information into memory until the home mesh network is reached or until the monitoring appliance reaches an internet access point. While the wearable appliance is outside of the mesh network range, the device searches for a cell phone with an expansion card plugged into a cell phone expansion slot such as the SDIO slot. If the wearable appliance detects a cell phone that is mesh network compatible, the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection. In one embodiment, a Zigbee SDIO card from C-guys, Inc., enables device-to-device communications for PDAs and smart phones. C-guys' ZigBee SDIO card includes the company's CG-100 SDIO application interface controller, which is designed to convert an application signal to an SD signal (or vice versa). The ZigBee card can provide signal ranges of up to 10 m in the 2.4 GHz band and data rates of up to 200 kbps. The card has peer-to-peer communications mode and supports direct application to PDAs or any SD supported hand-held cell phones. In this embodiment, the PDA or cell phone can provide a GPS position information instead of the indoor position information generated by the mesh network appliances 8. The cell phone GPS position information, accelerometer information and vital information such as heart rate information is transmitted using the cellular channel to the server 200 for processing as is normal. In another embodiment where the phone works through WiFi (802.11) or WiMAX (802.16) or ultra-wideband protocol instead of the cellular protocol, the wearable appliance can communicate over these protocols using a suitable mesh network interface to the phone. In instances where the wearable appliance is outside of its home base and a dangerous condition such as a fall is detected, the wearable appliance can initiate a distress call to the authorized third party using cellular, WiFi, WiMAX, or UWB protocols as is available. Tran at 33:58-34:40. FIG. 6A shows a portable embodiment of the present invention where the voice recognizer is housed in a wrist-watch. As shown in FIG. 6, the device includes a wrist-watch sized case 1380 supported on a wrist band 1374. The case 1380 may be of a number of variations of shape but can be conveniently made a rectangular, approaching a box-like configuration. The wrist-band 1374 can be an expansion band or a wristwatch strap of plastic, leather or woven material. The processor or CPU of the wearable appliance is connected to a radio frequency (RF) transmitter/receiver (such as a Bluetooth device, a Zigbee device, a WiFi device, a WiMAX device, or an 802.X transceiver, among others. Tran at 34:41-54

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	Turning now to FIG. 12, a jewelry-sized monitoring device is illustrated. In this embodiment, a body 172 houses a microphone port 174 and a speaker port 176. The body 172 is coupled to the user via the necklace 178 so as to provide a personal, highly accessible personal computer. Due to space limitations, voice input/output is an important user interface of the jewelry-sized computer. Although a necklace is disclosed, one skilled in the art can use a number of other substitutes such as a belt, a brace, a ring, or a band to secure the jewelry-sized computer to the user. Tran at 68:14-23 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Tran discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. In another aspect, heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at 3:6-13 The base station 20 frequently collects and synchronizes data from the appliances 8. The base station 20 may use one of various transportation methods to connect to the repository on the server 200 using a PC as conduit or through a connection established using an embedded modem (connected to a phone line), a wireless router (DSL or cable wireless router), a cellular modem, or another network-connected

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	appliance (such as, but not limited to, a web-phone, video-phone, embedded computer, PDA or handheld computer). Tran at 27:9-17.  FIG. 1 Tran at Fig. 1. In one embodiment, a physician, other health care practitioner, or emergency personnel is provided with access to patient medical information through the server 200. In one embodiment, if the wearable appliance detects that the patient needs help, or if the patient decides help is needed, the system can call his or her primary care physician. If the patient is unable to access his or her primary care physician (or another practicing physician providing care to the patient) a call from the patient is received, by an answering service or a call center associated with the patient or with the practicing physician. The call center determines whether the patient is exhibiting symptoms of an emergency condition by polling vital patient information generated by the wearable device, and if so, the answering service contacts 911

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	emergency service or some other emergency service. The call center can review falls information, blood pressure information, and other vital information to determine if the patient is in need of emergency assistance. If it is determined that the patient in not exhibiting symptoms of an emergent condition, the answering service may then determine if the patient is exhibiting symptoms of a non-urgent condition. If the patient is exhibiting symptoms of a non-urgent condition, the answering service will inform the patient that he or she may log into the server 200 for immediate information on treatment of the condition. If the answering service determines that the patient is exhibiting symptoms that are not related to a non-urgent condition, the answering service may refer the patient to an emergency room, a clinic, the practicing physician (when the practicing physician is available) for treatment. Tran at 29:1-29 In one embodiment, if the patient is outside of the mesh network range such as when the user is traveling away from his/her home, the system continuously records information into memory until the home mesh network is reached or until the monitoring appliance reaches an internet access point. While the wearable appliance is outside of the mesh network range, the device searches for a cell phone with an expansion card plugged into a cell phone expansion slot such as the SDIO slot. If the wearable appliance detects a cell phone that is mesh network compatible, the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection. In one embodiment, a Zigbee SDIO card from C-guys, Inc., enables device-to-device communications for PDAs and smart phones. C-guys' ZigBee SDIO card includes the company's CG-100 SDIO application interface controller, which is designed to convert an application signal to an SD signal (or vice versa). The ZigBee card can provide signal ranges of up to 10 m in the 2.4 GHz band and data rates of up to 200 kbps. The card has peer-to-peer communications mode and supports direct application to PDAs or any SD supported hand-held cell phones. In this embodiment, the PDA or cell phone can provide a GPS position information instead of the indoor position information generated by the mesh network appliances 8. The cell phone GPS position information, accelerometer information and vital information such as heart rate information is transmitted using the cellular channel to the server 200 for processing as is normal. In another embodiment where the phone works through WiFi (802.11) or WiMAX (802.16) or ultra-wideband protocol instead of the cellular protocol, the wearable appliance can communicate over these protocols using a suitable mesh network interface to the phone. In instances where the wearable appliance is outside of its home base and a dangerous condition such as a fall is detected, the wearable appliance can initiate a distress call to the authorized third party using cellular, WiFi, WiMAX, or UWB protocols as is available.

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	Tran at 34:4-40 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Tran discloses or renders obvious wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. In another aspect, heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at 3:6-13 The patient 30 may wear one or more wearable patient monitoring appliances such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance Such as a wrist-watch includes sensors 40. for example devices for sensing ECG, EKG, blood pressure, sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient’s wrist (such as a wristwatch sensor) and other convenient anatomical locations. Exemplary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascular system (ECG). Leg sensors can include piezoelectric accelerometers designed to give qualitative assessment of limb movement. Additionally, thoracic and

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	abdominal bands used to measure expansion and contraction of the thorax and abdomen respectively. A Small sensor can be mounted on the subjects finger in order to detect blood-oxygen levels and pulse rate. Additionally, a microphone can be attached to throat and used in sleep diagnostic recordings for detecting breathing and other noise. One or more position sensors can be used for detecting orientation of body (lying on left side, right side or back) during sleep diagnostic recordings. Each of sensors 40 can individually transmit data to the server 20 using wired or wireless transmission. Alternatively, all sensors 40 can be fed through a common bus into a single transceiver for wired or wireless transmission. The transmission can be done using a magnetic medium Such as a floppy disk or a flash memory card, or can be done using infrared or radio network link, among others. The sensor 40 can also include an indoor positioning system or alternatively a global position system (GPS) receiver that relays the position and ambulatory patterns of the patient to the server 20 for mobility tracking. Tran at 9:23-54 In one embodiment, the server 20 feeds the data to a statistical analyzer such as a neural network which has been trained to flag potentially dangerous conditions. The neural network can be a back-propagation neural network, for example. In this embodiment, the statistical analyzer is trained with training data where certain signals are determined to be undesirable for the patient, given his age, weight, and physical limitations, among others. For example, the patient’s glucose level should be within a well established range, and any value outside of this range is flagged by the statistical analyzer as a dangerous condition. As used herein, the dangerous condition can be specified as an event or a pattern that can cause physiological or psychological damage to the patient. Moreover, interactions between different vital signals can be accounted for so that the statistical analyzer can take into consideration instances where individually the vital signs are acceptable, but in certain combinations, the vital signs can indicate potentially dangerous conditions. Once trained, the data received by the server 20 can be appropriately scaled and processed by the statistical analyzer. In addition to statistical analyzers, the server 20 can process vital signs using rule-based inference engines, fuzzy logic, as well as conventional if-then logic. Additionally, the server can process vital signs using Hidden Markov Models (HMMs), dynamic time warping, or template matching, among others. Tran at 11:6-30 In one embodiment, data driven analyzers may be used to track the patients habits. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric

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	Statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models of the patient’s habits or ambulation patterns are built using one or more training sessions. Tran at 22:23-30 In one embodiment, data driven analyzers may be used to track the patient's risk of stroke or heart attack. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models of the patient stoke patterns are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accuracy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate data set referred to as a test set for training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set. The selection of the analyzer or model parameters is performed iteratively until the performance of the analyzer in classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross-validation, a single training data set is selected. Next, a number of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure is then determined on the basis of the combined performance of all models or analyzers. Under the cross-validation approach, the analyzer or model is typically retrained with data using the determined optimal model structure. Tran at 54:35-55:3 In one embodiment, feed forward artificial neural networks (NNs) are used to classify valve-related heart disorders. The heart sounds are captured using the microphone or piezoelectric transducer. Relevant features were extracted using several signal processing tools, discrete wavelet transfer, fast fourier transform, and linear prediction coding. The heart beat sounds are processed to extract the necessary

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	features by: a) denoising using wavelet analysis, b) separating one beat out of each record c) identifying each of the first heart sound (FHS) and the second heart sound (SHS). Valve problems are classified according to the time separation between the FHS and the SHS relative to cardiac cycle time, namely whether it is greater or smaller than 20% of cardiac cycle time. In one embodiment, the NN comprises 6 nodes at both ends, with one hidden layer containing 10 nodes. In another embodiment, linear predictive code (LPC) coefficients for each event were fed to two separate neural networks containing hidden neurons. Tran at 74:45-62. In another embodiment, the heart sounds are denoised using six-stage wavelet decomposition, thresholding, and then reconstruction. Three feature extraction techniques were used: the Decimation method, and the wavelet method. Classification of the heart diseases is done using Hidden Markov Models (HMMs). Tran at 75:1-6 The Markov model is formed for a reference pattern from a plurality of sequences of training patterns and the output symbol probabilities are multivariate Gaussian function probability densities. The heart sound traverses through the feature extractor. During learning, the resulting feature vector series is processed by a parameter estimator, whose output is provided to the hidden Markov model. The hidden Markov model is used to derive a set of reference pattern templates, each template representative of an identified S1-S4 pattern in a vocabulary set of reference patterns. The Markov model reference templates are next utilized to classify a sequence of observations into one of the reference patterns based on the probability of generating the observations from each Markov model reference pattern template. During recognition, the unknown pattern can then be identified as the reference pattern with the highest probability in the likelihood calculator. Tran at 80:55-81:3. An EKG analyzer is provided to interpret EKG/ECG data and generate warnings if needed. Tran at 85:60-61

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	If any of the above tests indicate a possible stroke, the system displays a warning to the patient and also connects the patient to the appropriate emergency response authority, family member, or physician. Tran at 87:33-37 If the variance between historical and current strength exceeds threshold, the process generates warnings (3208). Tran at 88:48-50 In yet another embodiment, the EMG data is used to detect muscle fatigue and to generate a warning to the patient to get to a resting place or a notification to a nurse or caregiver to render timely assistance. Tran at 90:58-61 In addition to stroke detection, EMG can be used to sense isometric muscular activity (type of muscular activity that does not translate into movement). This feature makes it possible to define a class of subtle motionless gestures to control interface without being noticed and without disrupting the surrounding environment. Using EMG, the user can react to the cues in a subtle way, without disrupting their environment and without using their hands on the interface. The EMG controller does not occupy the user's hands, and does not require them to operate it; hence it is “hands free”. The system can be used in interactive computer gaming which would have access to heart rate, galvanic skin response, and eye movement signals, so the game could respond to a player's emotional state or guess his or her level of situation awareness by monitoring eye movements. EMG/EEG signal can be used for man-machine interfaces by directly connecting a person to a computer via the human electrical nervous system. Based on EMG and EEG signals, the system applies pattern recognition system to interpret these signals as computer control commands. The system can also be used for Mime Speech Recognition which recognizes speech by observing the muscle associated with speech and is not based on voice signals but EMG. The MSR realizes unvoiced communication and because voice signals are not used, MSR can be applied in noisy environments; it can support people without vocal cords and aphasics. In another embodiment, EMG and/or electroencephalogram (EEG) features are used for predicting behavioral alertness levels. EMG and EEG features were derived from temporal, frequency spectral, and statistical analyses. Behavioral alertness levels were quantified by correct rates of performance on an auditory and a visual vigilance task, separately. A subset of three EEG features, the relative spectral amplitudes in the

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	alpha (alpha %, 8-13 Hz) and theta (theta %, 4-8 Hz) bands, and the mean frequency of the EEG spectrum (MF) can be used for predicting the auditory alertness level. Tran at 96:17-53. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Tran discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. *See* claim 11 above. The patient 30 may wear one or more wearable patient monitoring appliances such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance Such as a wrist-watch includes sensors 40. for example devices for sensing ECG, EKG, blood pressure, sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient’s wrist (such as a wristwatch sensor) and other convenient anatomical locations. Exemplary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascular system (ECG). Leg sensors can include piezoelectric accelerometers designed to give qualitative assessment of limb movement. Additionally, thoracic and abdominal bands used to measure expansion and contraction of the thorax and abdomen respectively. A Small sensor can be mounted on the subjects finger in order to detect blood-oxygen levels and pulse rate. Additionally, a microphone can be attached to throat and used in sleep diagnostic recordings for detecting breathing and other noise. One or more position sensors can be used for detecting orientation of body (lying on left side, right side or back) during sleep diagnostic recordings. Each of sensors 40 can individually transmit data to the server 20 using wired or wireless transmission. Alternatively, all sensors 40 can be fed through a common bus into a single transceiver for wired or wireless

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	Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination. Tran at 23:39-50 The hidden Markov model is used to derive a set of reference pattern templates, each template representative of an identified pattern in a vocabulary set of reference treatment patterns. The Markov model reference templates are next utilized to classify a sequence of observations into one of the reference patterns based on the probability of generating the observations from each Markov model reference pattern template. During recognition, the unknown pattern can then be identified as the reference pattern with the highest probability in the likelihood calculator. The HMM template has a number of states, each having a discrete value. However, because treatment pattern features may have a dynamic pattern in contrast to a single value. The addition of a neural network at the front end of the HMM in an embodiment provides the capability of representing states with dynamic values. Tran at 24:45-60. In one embodiment, feed forward artificial neural networks (NNs) are used to classify valve-related heart disorders. The heart sounds are captured using the microphone or piezoelectric transducer. Relevant features were extracted using several signal processing tools, discrete wavelet transfer, fast fourier transform, and linear prediction coding. The heart beat sounds are processed to extract the necessary features by: a) denoising using wavelet analysis, b) separating one beat out of each record c) identifying each of the first heart sound (FHS) and the second heart sound (SHS). Valve problems are classified according to the time separation between the FHS and the SHS relative to cardiac cycle time, namely whether it is greater or smaller than 20% of cardiac cycle time. In one embodiment, the NN comprises 6 nodes at both ends, with one hidden layer containing 10 nodes. In another embodiment, linear predictive code (LPC) coefficients for each event were fed to two separate neural networks containing hidden neurons. Tran at 74:45-62 In another embodiment, the heart sounds are denoised using six-stage wavelet decomposition, thresholding, and then reconstruction. Three feature extraction techniques were used: the Decimation

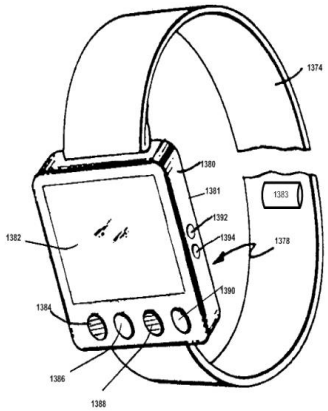
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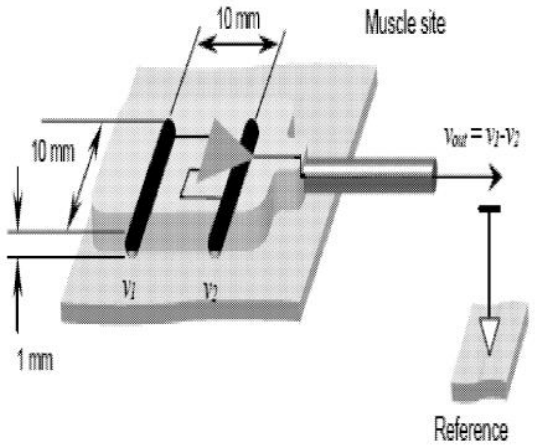
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	method, and the wavelet method. Classification of the heart diseases is done using Hidden Markov Models (HMMs). Tran at 75:1-6 A Hidden Markov model can be used in one embodiment to evaluate the probability of occurrence of a sequence of observations O(1), O(2), O(t), ..., O(T), where each observation O(t) may be either a discrete symbol under the VO approach or a continuous vector. The sequence of observations may be modeled as a probabilistic function of an underlying Markov chain having State transitions that are not directly observable. The transitions between states are represented by a transition matrix A=[a(i,j)]. Each a(i,j) term of the transition matrix is the probability of making a transition to state given that the model is in state i. The output symbol probability of the model is represented by a set of functions B-b(i)(O(t), where the b()(O(t) term of the output symbol matrix is the probability of outputting observation O(t), given that the model is in state j. The first state is always constrained to be the initial state for the first time frame of the utterance, as only a prescribed set of left-to-right state transitions are possible. A predetermined final state is defined from which transitions to other states cannot occur. Transitions are restricted to reentry of a state or entry to one of the next two states. Such transitions are defined in the model as transition probabilities. For example, a heart sound pattern currently having a frame of feature signals in state 2 has a probability of reentering state 2 of a(2,2), a probability a(2,3) of entering state 3 and a probability of a(2,4)=1-a(2,1)-a(2,2) of entering state 4. The probability a(2.1) of entering state 1 or the probability a? 2.5) of entering state 5 is Zero and the sum of the probabilities a(2.1) through a(2.5) is one. Although the preferred embodiment restricts the flow graphs to the present state or to the next two states, one skilled in the art can build an HMM model without any transition restrictions. The Markov model is formed for a reference pattern from a plurality of sequences of training patterns and the output symbol probabilities are multivariate Gaussian function probability densities. The heart sound traverses through the feature extractor. During learning, the resulting feature vector series is processed by a parameter estimator, whose output is provided to the hidden Markov model. The hidden Markov model is used to derive a set of reference pattern templates, each template representative of an identified S1-S4 pattern in a vocabulary set of reference patterns. The Markov model reference templates are next utilized to classify a sequence of observations into one of the reference patterns based on the probability of generating the observations from each Markov model reference pattern template. During

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	recognition, the unknown pattern can then be identified as the reference pattern with the highest probability in the likelihood calculator. Tran at 80:24- 81:3 In addition to stroke detection, EMG can be used to sense isometric muscular activity (type of muscular activity that does not translate into movement). This feature makes it possible to define a class of subtle motionless gestures to control interface without being noticed and without disrupting the surrounding environment. Using EMG, the user can react to the cues in a subtle way, without disrupting their environment and without using their hands on the interface. The EMG controller does not occupy the user's hands, and does not require them to operate it; hence it is “hands free”. The system can be used in interactive computer gaming which would have access to heart rate, galvanic skin response, and eye movement signals, so the game could respond to a player's emotional state or guess his or her level of situation awareness by monitoring eye movements. EMG/EEG signal can be used for man-machine interfaces by directly connecting a person to a computer via the human electrical nervous system. Based on EMG and EEG signals, the system applies pattern recognition system to interpret these signals as computer control commands. The system can also be used for Mime Speech Recognition which recognizes speech by observing the muscle associated with speech and is not based on voice signals but EMG. The MSR realizes unvoiced communication and because voice signals are not used, MSR can be applied in noisy environments; it can support people without vocal cords and aphasics. In another embodiment, EMG and/or electroencephalogram (EEG) features are used for predicting behavioral alertness levels. EMG and EEG features were derived from temporal, frequency spectral, and statistical analyses. Behavioral alertness levels were quantified by correct rates of performance on an auditory and a visual vigilance task, separately. A subset of three EEG features, the relative spectral amplitudes in the alpha (alpha %, 8-13 Hz) and theta (theta %, 4-8 Hz) bands, and the mean frequency of the EEG spectrum (MF) can be used for predicting the auditory alertness level. Tran at 96:17-53. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Tran discloses or renders obvious the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. *See* claim 11 above.  FIG. 6A Tran at Fig. 6a.

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	 FIG. 17A Tran at Fig. 17a. In one embodiment, data driven analyzers may be used to track the patients habits. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric Statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models of the patient’s habits or ambulation patterns are built using one or more training sessions. Tran at 22:23-31 In one embodiment, the back of the device is a conductive metal electrode 1381 that in conjunction with a second electrode 1383 mounted on the wrist band 1374, enables differential EKG or ECG to be measured. The electrical signal derived from the electrodes is typically 1 mV peak-peak. In one embodiment where only one electrode 1381 or 1383 is available, an amplification of about 1000 is necessary to render this signal usable for heart rate detection. In the embodiment with electrodes 1381 and 1383 available, a differential amplifier is used to take advantage of the identical common mode signals from the EKG contact points, the common mode noise is automatically cancelled out using a matched differential amplifier. In one embodiment, the differential amplifier is a Texas Instruments INA321 instrumentation amplifier that has matched and balanced integrated gain resistors. This device is specified to operate with a minimum of 2.7V single rail power supply. The INA321 provides a fixed

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	amplification of 5× for the EKG signal. With its CMRR specification of 94 dB extended up to 3 KHz the INA321 rejects the common mode noise signals including the line frequency and its harmonics. The quiescent current of the INA321 is 40 mA and the shut down mode current is less than 1 mA. The amplified EKG signal is internally fed to the on chip analog to digital converter. The ADC samples the EKG signal with a sampling frequency of 512 Hz. Precise sampling period is achieved by triggering the ADC conversions with a timer that is clocked from a 32.768 kHz low frequency crystal oscillator. The sampled EKG waveform contains some amount of super imposed line frequency content. This line frequency noise is removed by digitally filtering the samples. In one implementation, a 17-tap low pass FIR filter with pass band upper frequency of 6 Hz and stop band lower frequency of 30 Hz is implemented in this application. The filter coefficients are scaled to compensate the filter attenuation and provide additional gain for the EKG signal at the filter output. This adds up to a total amplification factor of greater than 1000× for the EKG signal. Tran at 34:53-35:22. In the electromagnetic sensor embodiment, the wrist band 1374 is a flexible plastic material incorporated with a flexible magnet. The magnet provides a magnetic field, and one or more electrodes similar to electrode 1383 are positioned on the wrist band to measure voltage drops which are proportional to the blood velocity. The electromagnetic embodiment may be mounted on the upper arm of the patient, on the ankle or on the neck where peripheral blood vessels pass through and their blood velocity may be measured with minimal interruptions. The flexible magnet produces a pseudo-uniform (non-gradient) magnetic field. The magnetic field can be normal to the blood flow direction when wrist band 1374 is mounted on the user's wrist or may be a rotative pseudo-uniform magnetic field so that the magnetic field is in a transversal direction in respect to the blood flow direction. The electrode output signals are processed to obtain a differential measurement enhancing the signal to noise ratio. The flow information is derived based on the periodicity of the signals. The decoded signal is filtered over several periods and then analyzed for changes used to estimate artery and vein blood flow. Systemic stroke volume and cardiac output may be calculated from the peripheral SV index value. Tran at 37:13-34 In one embodiment, data driven analyzers may be used to track the patient’s risk of stroke or heart attack. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression

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	methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models of the patient stoke patterns are built using one or more training sessions. Tran at 54:35-42 In one EKG or ECG detector, the heartbeat detection circuitry includes a differential amplifier for amplifying the signal transmitted from the EKG/ECG electrodes and for converting it into single-ended form, and a bandpass filter and a 60 Hz notch filter for removing background noise. The CPU measures the time durations between the successive pulses and estimates the heartbeat rate. The time durations between the successive pulses of the pulse sequence signal provides an estimate of heartbeat rate. Each time duration measurement is first converted to a corresponding rate, preferably expressed in beats per minute (bpm), and then stored in a file, taking the place of the earliest measurement previously stored. After a new measurement is entered into the file, the stored measurements are averaged, to produce an average rate measurement. The CPU optionally determines which of the stored measurements differs most from the average, and replaces that measurement with the average. Tran at 60:27-43 In yet another embodiment, a local signal analysis is used with a classifier to detect, characterize, and interpret sounds corresponding to symptoms important for cardiac diagnosis. The system detects a plurality of different heart conditions. Heart sounds are automatically segmented into a segment of a single heart beat cycle. Each segment are then transformed using 7 level wavelet decomposition, based on Coifman 4th order wavelet kernel. The resulting vectors 4096 values, are reduced to 256 element feature vectors, this simplified the neural network and reduced noise. Tran at 76:11-20. In one embodiment of the feature extractor, the digitized heart sound signal series s(n) is put through a low-order filter, typically a first-order finite impulse response filter, to spectrally flatten the signal and to make the signal less susceptible to finite precision effects encountered later in the signal processing. The signal is pre-emphasized preferably using a fixed pre-emphasis network, or preemphasizer. The signal can also be passed through a slowly adaptive pre-emphasizer. The preemphasized heart sound signal is next presented to a frame blocker to be blocked into frames of N samples with adjacent frames being separated by M samples. In one implementation, frame 1 contains the first 400 samples. The frame

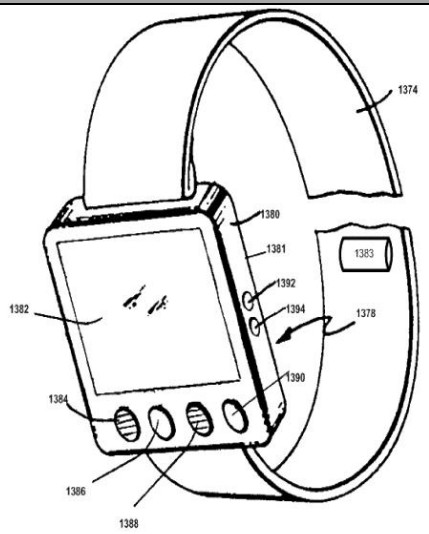
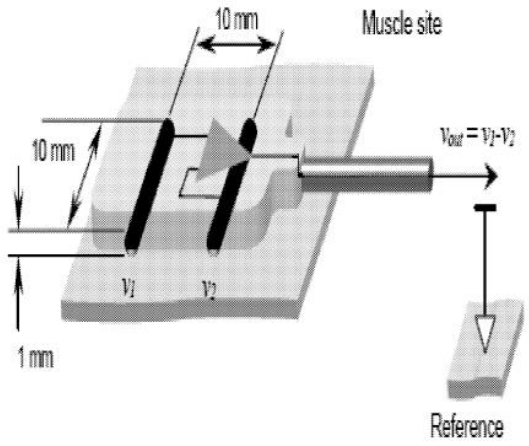
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	2 also contains 400 samples, but begins at the 300th sample and continues until the 700th sample. Because the adjacent frames overlap, the resulting LPC spectral analysis will be correlated from frame to frame. Each frame is windowed to minimize signal discontinuities at the beginning and end of each frame. The windower tapers the signal to zero at the beginning and end of each frame. Preferably, the window used for the autocorrelation method of LPC is the Hamming window. A noise canceller operates in conjunction with the autocorrelator to minimize noise. Noise in the heart sound pattern is estimated during quiet periods, and the temporally stationary noise sources are damped by means of spectral subtraction, where the autocorrelation of a clean heart sound signal is obtained by subtracting the autocorrelation of noise from that of corrupted heart sound. In the noise cancellation unit, if the energy of the current frame exceeds a reference threshold level, the heart is generating sound and the autocorrelation of coefficients representing noise is not updated. However, if the energy of the current frame is below the reference threshold level, the effect of noise on the correlation coefficients is subtracted off in the spectral domain. The result is half-wave rectified with proper threshold setting and then converted to the desired autocorrelation coefficients. Tran at 76:54-77:21. The interval between each successive pair of same direction, either positive or negative going, crossings of each predetermined sound intensity level is determined and a count of the inverse of these interspike intervals of the multilevel detectors for each spectral portion is stored as a function of frequency. The resulting histogram of the ensemble of inverse interspike intervals forms a spectral pattern that is representative of the spectral distribution of the auditory neural response to the input sound and is relatively insensitive to noise The use of a plurality of logarithmically related sound intensity levels accounts for the intensity of the input signal in a particular frequency range. Thus, a signal of a particular frequency having high intensity peaks results in a much larger count for that frequency than a low intensity signal of the same frequency. The multiple level histograms of the type described herein readily indicate the intensity levels of the nerve firing spectral distribution and cancel noise effects in the individual intensity level histograms. Alternatively, the fractal parameter block can further be used alone or in conjunction with others to represent spectral information. Fractals have the property of self similarity as the spatial scale is changed over many orders of magnitude. A fractal function includes both the basic form inherent in a shape and the statistical or random properties of the replacement of that shape in space. As is known in the art, a fractal generator employs mathematical operations known as local affine transformations. These transformations are employed in the process of encoding digital data representing spectral data. The encoded output constitutes a “fractal transform” of the spectral data and

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	consists of coefficients of the affine transformations. Different fractal transforms correspond to different images or sounds. Tran at 77:67-78:31. As shown in FIG. 17A, to eliminate the potentially much greater noise signal from power line sources, a differential instrumentation amplifier is employed. Any signal that originates far away from the detection sites will appear as a common signal, whereas signals in the immediate vicinity of the detection surfaces will be different and consequently will be amplified. Thus, relatively distant power lines noise signals will be removed and relatively local EMG signals will be amplified. The source impedance at the junction of the skin and detection surface may range from several thousand ohms to several megohms for dry skin. In order to prevent attenuation and distortion of the detected signal due to the effects of input loading, the input impedance of the differential amplifier is as large as possible, without causing ancillary complications to the workings of the differential amplifier. The signal to noise ratio is increased by filtering between 20-500 Hz with a roll-off of 12 dB/octave. Tran at 91:12-28. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of	Tran discloses or renders obvious the measurement system configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above.

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semiconductor sources from an initial non-zero pulse rate.	 FIG. 6A Tran at Fig. 6a.  FIG. 17A Tran at Fig. 17a.

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	In one embodiment, the back of the device is a conductive metal electrode 1381 that in conjunction with a second electrode 1383 mounted on the wrist band 1374, enables differential EKG or ECG to be measured. The electrical signal derived from the electrodes is typically 1 mV peak-peak. In one embodiment where only one electrode 1381 or 1383 is available, an amplification of about 1000 is necessary to render this signal usable for heart rate detection. In the embodiment with electrodes 1381 and 1383 available, a differential amplifier is used to take advantage of the identical common mode signals from the EKG contact points, the common mode noise is automatically cancelled out using a matched differential amplifier. In one embodiment, the differential amplifier is a Texas Instruments INA321 instrumentation amplifier that has matched and balanced integrated gain resistors. This device is specified to operate with a minimum of 2.7V single rail power supply. The INA321 provides a fixed amplification of 5× for the EKG signal. With its CMRR specification of 94 dB extended up to 3 KHz the INA321 rejects the common mode noise signals including the line frequency and its harmonics. The quiescent current of the INA321 is 40 mA and the shut down mode current is less than 1 mA. The amplified EKG signal is internally fed to the on chip analog to digital converter. The ADC samples the EKG signal with a sampling frequency of 512 Hz. Precise sampling period is achieved by triggering the ADC conversions with a timer that is clocked from a 32.768 kHz low frequency crystal oscillator. The sampled EKG waveform contains some amount of super imposed line frequency content. This line frequency noise is removed by digitally filtering the samples. In one implementation, a 17-tap low pass FIR filter with pass band upper frequency of 6 Hz and stop band lower frequency of 30 Hz is implemented in this application. The filter coefficients are scaled to compensate the filter attenuation and provide additional gain for the EKG signal at the filter output. This adds up to a total amplification factor of greater than 1000× for the EKG signal. Tran at 34:53-35:22 In the electromagnetic sensor embodiment, the wrist band 1374 is a flexible plastic material incorporated with a flexible magnet. The magnet provides a magnetic field, and one or more electrodes similar to electrode 1383 are positioned on the wrist band to measure voltage drops which are proportional to the blood velocity. The electromagnetic embodiment may be mounted on the upper arm of the patient, on the ankle or on the neck where peripheral blood vessels pass through and their blood velocity may be measured with minimal interruptions. The flexible magnet produces a pseudo-uniform (non-gradient) magnetic field. The magnetic field can be normal to the blood flow direction when wrist band 1374 is mounted on the user's wrist or may be a rotative pseudo-uniform magnetic field so that the magnetic field

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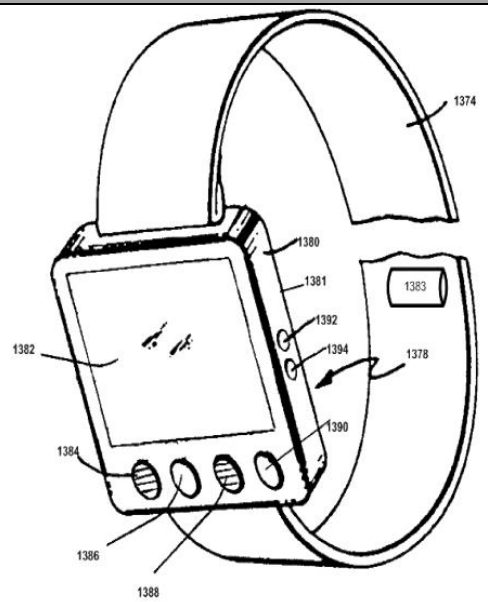
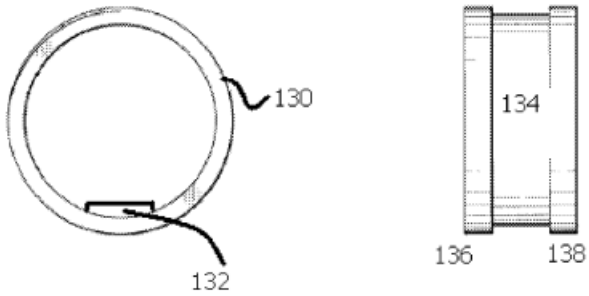
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	is in a transversal direction in respect to the blood flow direction. The electrode output signals are processed to obtain a differential measurement enhancing the signal to noise ratio. The flow information is derived based on the periodicity of the signals. The decoded signal is filtered over several periods and then analyzed for changes used to estimate artery and vein blood flow. Systemic stroke volume and cardiac output may be calculated from the peripheral SV index value. Tran at 37:13-34. In one EKG or ECG detector, the heartbeat detection circuitry includes a differential amplifier for amplifying the signal transmitted from the EKG/ECG electrodes and for converting it into single-ended form, and a bandpass filter and a 60 Hz notch filter for removing background noise. The CPU measures the time durations between the successive pulses and estimates the heartbeat rate. The time durations between the successive pulses of the pulse sequence signal provides an estimate of heartbeat rate. Each time duration measurement is first converted to a corresponding rate, preferably expressed in beats per minute (bpm), and then stored in a file, taking the place of the earliest measurement previously stored. After a new measurement is entered into the file, the stored measurements are averaged, to produce an average rate measurement. The CPU optionally determines which of the stored measurements differs most from the average, and replaces that measurement with the average. Tran at 60:27-43. In one embodiment of the feature extractor, the digitized heart sound signal series s(n) is put through a low-order filter, typically a first-order finite impulse response filter, to spectrally flatten the signal and to make the signal less susceptible to finite precision effects encountered later in the signal processing. The signal is pre-emphasized preferably using a fixed pre-emphasis network, or preemphasizer. The signal can also be passed through a slowly adaptive pre-emphasizer. The preemphasized heart sound signal is next presented to a frame blocker to be blocked into frames of N samples with adjacent frames being separated by M samples. In one implementation, frame 1 contains the first 400 samples. The frame 2 also contains 400 samples, but begins at the 300th sample and continues until the 700th sample. Because the adjacent frames overlap, the resulting LPC spectral analysis will be correlated from frame to frame. Each frame is windowed to minimize signal discontinuities at the beginning and end of each frame. The windower tapers the signal to zero at the beginning and end of each frame. Preferably, the window used for the autocorrelation method of LPC is the Hamming window. A noise canceller operates in conjunction with the autocorrelator to minimize noise. Noise in the heart sound pattern is estimated

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	during quiet periods, and the temporally stationary noise sources are damped by means of spectral subtraction, where the autocorrelation of a clean heart sound signal is obtained by subtracting the autocorrelation of noise from that of corrupted heart sound. In the noise cancellation unit, if the energy of the current frame exceeds a reference threshold level, the heart is generating sound and the autocorrelation of coefficients representing noise is not updated. However, if the energy of the current frame is below the reference threshold level, the effect of noise on the correlation coefficients is subtracted off in the spectral domain. The result is half-wave rectified with proper threshold setting and then converted to the desired autocorrelation coefficients. Tran at 76:54-77:21. The interval between each successive pair of same direction, either positive or negative going, crossings of each predetermined sound intensity level is determined and a count of the inverse of these interspike intervals of the multilevel detectors for each spectral portion is stored as a function of frequency. The resulting histogram of the ensemble of inverse interspike intervals forms a spectral pattern that is representative of the spectral distribution of the auditory neural response to the input sound and is relatively insensitive to noise The use of a plurality of logarithmically related sound intensity levels accounts for the intensity of the input signal in a particular frequency range. Thus, a signal of a particular frequency having high intensity peaks results in a much larger count for that frequency than a low intensity signal of the same frequency. The multiple level histograms of the type described herein readily indicate the intensity levels of the nerve firing spectral distribution and cancel noise effects in the individual intensity level histograms. Alternatively, the fractal parameter block can further be used alone or in conjunction with others to represent spectral information. Fractals have the property of self similarity as the spatial scale is changed over many orders of magnitude. A fractal function includes both the basic form inherent in a shape and the statistical or random properties of the replacement of that shape in space. As is known in the art, a fractal generator employs mathematical operations known as local affine transformations. These transformations are employed in the process of encoding digital data representing spectral data. The encoded output constitutes a “fractal transform” of the spectral data and consists of coefficients of the affine transformations. Different fractal transforms correspond to different images or sounds. Tran at 77:67-78:31.

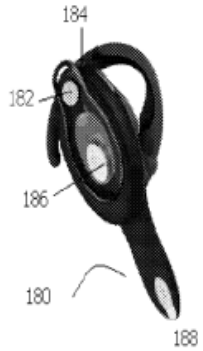
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	As shown in FIG. 17A, to eliminate the potentially much greater noise signal from power line sources, a differential instrumentation amplifier is employed. Any signal that originates far away from the detection sites will appear as a common signal, whereas signals in the immediate vicinity of the detection surfaces will be different and consequently will be amplified. Thus, relatively distant power lines noise signals will be removed and relatively local EMG signals will be amplified. The source impedance at the junction of the skin and detection surface may range from several thousand ohms to several megohms for dry skin. In order to prevent attenuation and distortion of the detected signal due to the effects of input loading, the input impedance of the differential amplifier is as large as possible, without causing ancillary complications to the workings of the differential amplifier. The signal to noise ratio is increased by filtering between 20-500 Hz with a roll-off of 12 dB/octave. Tran at 91:12-28. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective	Tran discloses wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above.

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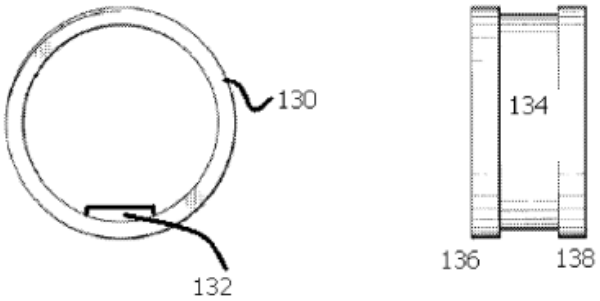
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surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	 FIG. 6A Tran at Fig. 6a.  FIG. 8

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	Tran at Fig.8.  FIG. 13 Tran at Fig. 13. In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12. In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implementation, a reflective sensor such as the Honeywell

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	HLC1395 can be used. The device emits lights from a window in the infrared spectrum and receives reflected light in a second window. When the heart beats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, and the resulting optical waveform is captured by the CPU. Tran at 60:58-61:5 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40. FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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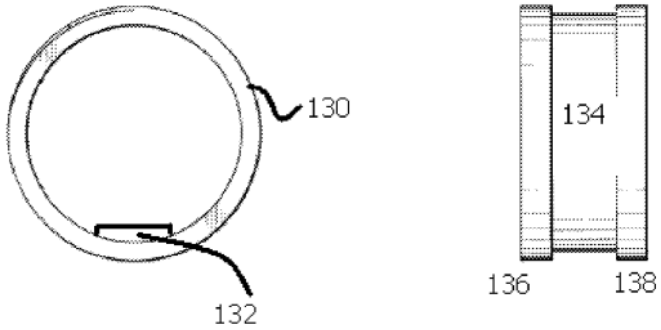
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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Tran discloses or renders obvious wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above.  FIG. 8 Tran at Fig.8.

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	 FIG. 13 Tran at Fig. 13. Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40. FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is

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	provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Tran discloses that wherein the first arc and the second arc are concentric. *See* claim 15 above.

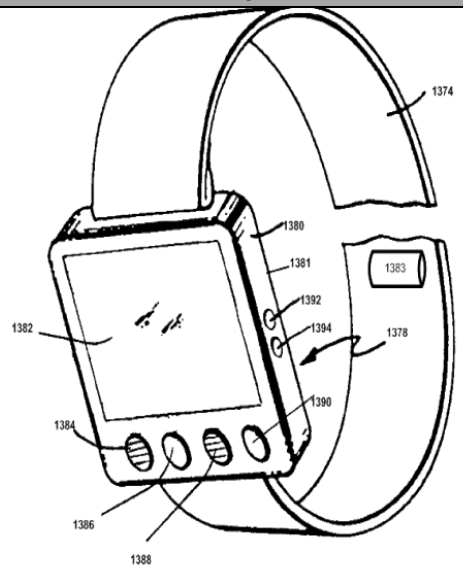
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	 FIG. 8 Tran at Fig.8 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Tran discloses or renders obvious a wearable device for use with a smart phone or tablet, the wearable device comprising. *See* claim 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	Tran discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the	Tran discloses or renders obvious to generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths.

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semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	 FIG. 6A Tran at Fig. 6a.  FIG. 13 Tran at Fig. 13.

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	In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12. The wrist band 1374 can also contain other electrical devices such as ultrasound transducer, optical transducer or electromagnetic sensors, among others. In one embodiment, the transducer is an ultrasonic transducer that generates and transmits an acoustic wave upon command from the CPU during one period and listens to the echo returns during a subsequent period. In use, the transmitted bursts of sonic energy are scattered by red blood cells flowing through the subject's radial artery, and a portion of the scattered energy is directed back toward the ultrasonic transducer 84. The time required for the return energy to reach the ultrasonic transducer varies according to the speed of sound in the tissue and according to the depth of the artery. Typical transit times are in the range of 6 to 7 microseconds. The ultrasonic transducer is used to receive the reflected ultrasound energy during the dead times between the successive transmitted bursts. The frequency of the ultrasonic transducer's transmit signal will differ from that of the return signal, because the scattering red blood cells within the radial artery are moving. Thus, the return signal, effectively, is frequency modulated by the blood flow velocity. Tran at 35:23-43 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such

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	as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Tran discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured	Tran discloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue.

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light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue.	*See* 11[d],11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Tran discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Tran discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Tran discloses or renders obvious increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[a], 11[b], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Tran discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless	Tran discloses or renders obvious configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* 11[k], 19[pre].

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receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link	Tran discloses or renders obvious the smart phone or tablet configured to:receive and to process at least a portion of the output signal, store and display the processed output signal, tore and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of	Tran discloses or renders obvious wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 13, 19 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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semiconductor sources from an initial non-zero pulse rate.	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Tran discloses or renders obvious wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Tran discloses or renders obvious wherein the first arc and the second arc are concentric. *See* claim 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D14

U.S. Pat. No. 10,874,304 in view of U.S. Patent Publication No 20120197093 to "Valencell"

As described in detail below, Valencell (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D13 and D15-D19 the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. . This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Valencell. The cited portions of Valencell are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Valencell. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Valencell "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Valencell does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Valencell (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Valencell anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 11	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Valencell discloses or renders obvious a measurement system. Apparatus and methods for attenuating environmental interference are described. A wearable monitoring apparatus includes a housing configured to be attached to the body of a subject and a sensor module that includes an energy emitter that directs energy at a target region of the subject, a detector that detects an energy response signal—or physiological condition—from the subject, a filter that removes time-varying environmental interference from the energy response signal, and at least one processor that controls operations of the energy emitter, detector, and filter. Valencell at Abstract. According to some embodiments of the present invention, a medium (e.g., physiological material of a subject), having a region of interest, is monitored via a sensor module having at least one energy emitter for interrogating the medium with energy to generate an energy response associated with the medium, at least one circuit to drive at least one energy emitter, at least one detector for detecting the energy response associated with the medium, a filter that removes time-varying environmental interference from the energy response signal, and a processor that controls operations of the energy emitter, detector, and filter. Valencell at [0005] According to some embodiments of the present invention, a wearable monitoring apparatus includes a housing (e.g., an earpiece, earbud, etc.), and a sensor module disposed within or attached to the housing. The housing is configured to be attached to a body of a subject, for example the ear. The sensor module includes an energy emitter, a detector, a filter, and at least one processor. The energy emitter directs energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, mechanical energy, magnetic energy, nuclear energy, etc.) at a target region of the subject and the detector detects an energy response signal from the subject. The energy response signal is associated with a physiological condition of the subject (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.). The filter removes or attenuates time-varying

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	environmental interference from the energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Valencell at [0006] The detectors that may be incorporated into headsets, earbuds, and/or substrates (e.g., wristbands, armbands, legbands, neckbands, waistbands, anklebands, footbands, handbands, ringbands, headbands, etc.) according to some embodiments of the present invention, may be configured to detect and/or measure one or more of the following types of physiological information/conditions: heart rate, pulse rate, breathing rate, blood flow, VO2, VO2max, heartbeat signatures, cardio-pulmonary health, organ health, metabolism, electrolyte type and/or concentration, physical activity, caloric intake, caloric metabolism, blood metabolite levels or ratios, blood pH level, physical and/or psychological stress levels and/or stress level indicators, drug dosage and/or dosimetry, physiological drug reactions, drug chemistry, biochemistry, position and/or balance, body strain, neurological functioning, brain activity, brain waves, blood pressure, cranial pressure, hydration level, auscultatory information, auscultatory signals associated with pregnancy, physiological response to infection, skin and/or core body temperature, eye muscle movement, blood volume, inhaled and/or exhaled breath volume, physical exertion, exhaled breath physical and/or chemical composition, the presence and/or identity and/or concentration of viruses and/or bacteria, foreign matter in the body, internal toxins, heavy metals in the body, anxiety, fertility, ovulation, sex hormones, psychological mood, sleep patterns, hunger and/or thirst, hormone type and/or concentration, cholesterol, lipids, blood panel, bone density, organ and/or body weight, reflex response, sexual arousal, mental and/or physical alertness, sleepiness, auscultatory information, response to external stimuli, swallowing volume, swallowing rate, sickness, voice characteristics, voice tone, voice pitch, voice volume, vital signs, head tilt, allergic reactions, inflammation response, auto-immune response, mutagenic response, DNA, proteins, protein levels in the blood, water content of the blood, pheromones, internal body sounds, digestive system functioning, cellular regeneration response, healing response, stem cell regeneration response, etc Valencell at [0050] The term "monitoring" refers to the act of measuring, quantifying, qualifying, estimating, sensing, calculating, interpolating, extrapolating, inferring, deducing, or any combination of these actions. More generally, "monitoring" refers to a way of getting information via one or more sensing elements. For

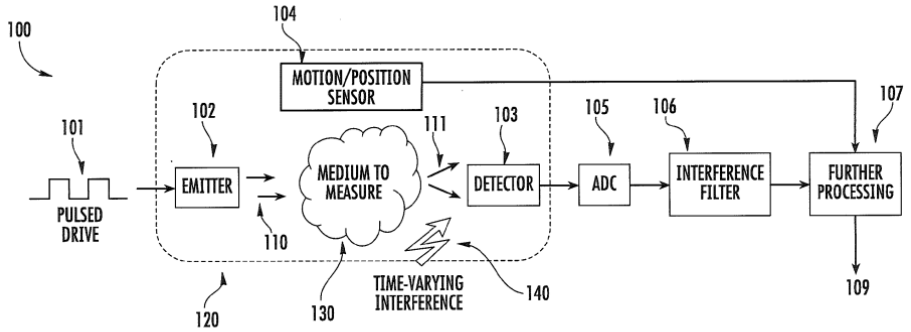
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	example, "blood health monitoring" includes monitoring blood gas levels, blood hydration, and metabolite/electrolyte levels. Valencell at [0099]. Embodiments of the present invention are not limited to headsets that communicate wirelessly. In some embodiments of the present invention, headsets configured to monitor an individual's physiology and/or environment may be wired to a device that stores and/or processes data or there may be a combination of wired and wireless communications. In some embodiments, this information may be stored on the headset itself. Furthermore, embodiments of the present invention are not limited to earbuds. In some embodiments, the invention may be employed around another part of the body, such as a digit, finger, toe, limb, wrist, ankle, around the nose or earlobe, or the like. In other embodiments, the invention may be integrated into a patch, such as a bandage that sticks on a person's body. Valencell at [0106] FIG. 1 illustrates an interference filtering apparatus/method 100, according to some embodiments of the present invention. A medium 130, preferably physiological material of a living subject, comprises at least one target region of interest 120 which is interrogated by energy 110, preferably modulated energy, such as pulsed energy, generated by an energy emitter 102. A pulsed driving circuit 101 is used to drive at least one energy emitter 102 at one or more pulsed frequencies to interrogate at least one target region of at least one medium 130 with the pulsed energy 110. The energy may be in the form of electromagnetic, acoustical, mechanical, nuclear, electrical, magnetic, thermal, or other forms of energy, but typically optical energy from the electromagnetic spectrum. The energy reaching the medium 130 can interact with the medium to generate at least one energy response signal 111, such as an optical scatter signal 111 between emitted optical energy 110 and the medium 130. The energy response 111 caused by this interaction is detected by at least one detector 103, configured to detect energy in the forms described above, but typically in the form of optical energy scattered from the medium 130. A motion/position sensor 104 may be configured to measure movement, positional changes, or inertial changes in the vicinity of the medium 130. The outputs of the detector 103 may be sent to at least one analog-to-digital convertor (ADC) 105 and the digitized output may be sent to at least one interference filter 106, which is configured to remove the effects of time-varying environmental interference 140 from the signal output of the detector 103. At least one motion/position sensor 104 may be incorporated in the interference filtering method 100 to provide a reference signal for removing the effects of motion

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	from the extracted energy response signal 111 to produce a desired signal 109. For example, the output of the interference filter 106 may be further processed by signal extraction filter 107 to extract accurate information from the medium 130, and this signal extraction filter 107 may utilize the output of the motion/position sensor 104 to remove motion artifacts from the desired signal (the extracted energy response signal) 109. At least one signal processor (not shown) may be used to control the operations of the energy emitter 102, detector 103, filter 106, and/or other components of the interference filtering method 100. Valencell at [0107] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example,

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	caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108]  FIG. 1 Valencell at Fig.1 Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring

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	transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109] Monitoring apparatus, according to embodiments of the present invention can be adapted to fit around various parts of the body, such as an arm, leg, neck, etc. For example, monitoring apparatus, according to embodiments of the present invention can be implemented as a substrate, such as a wristband, armband, legband, neckband, waistband, ankleband, footband, handband, ringband, headband, or the like. The substrate may be flexible and may be configured to surround all or a portion of a body of a subject. The substrate may be configured to be attached to a body of a subject adhesively, similar to a bandage. The location of a sensor module (e.g., 700, 800) may be virtually any place along the skin of a subject; however, better PPG results may be obtained when a sensor module is placed along an major artery. Valencell at [0150] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Valencell discloses or renders obvious a a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths. Apparatus and methods for attenuating environmental interference are described. A wearable monitoring apparatus includes a housing configured to be attached to the body of a subject and a sensor module that includes an energy emitter that directs energy at a target region of the subject, a detector that detects an energy response signal—or physiological condition—from the subject, a filter that removes time-varying environmental interference from the energy response signal, and at least one processor that controls operations of the energy emitter, detector, and filter. Valencell at Abstract. According to some embodiments of the present invention, a medium (e.g., physiological material of a subject), having a region of interest, is monitored via a sensor module having at least one energy emitter for interrogating the medium with energy to generate an energy response associated with the medium, at least one circuit to drive at least one energy emitter, at least one detector for detecting the energy response associated with the medium, a filter that removes time-varying environmental interference from the energy response signal, and a processor that controls operations of the energy emitter, detector, and filter. Valencell at [0005] According to some embodiments of the present invention, a wearable monitoring apparatus includes a housing (e.g., an earpiece, earbud, etc.), and a sensor module disposed within or attached to the housing. The housing is configured to be attached to a body of a subject, for example the ear. The sensor module includes an energy emitter, a detector, a filter, and at least one processor. The energy emitter directs energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, mechanical energy, magnetic energy, nuclear energy, etc.) at a target region of the subject and the detector detects an energy response signal from the subject. The energy response signal is associated with a physiological condition of the subject (e.g., heart rate, pulse pressure, respiration rate, lactic

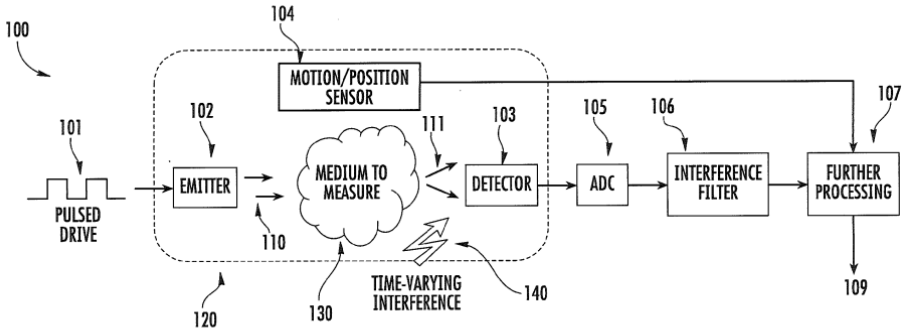
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	threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.). The filter removes or attenuates time-varying environmental interference from the energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Valencell at [0006] The at least one processor controls operations of the energy emitter, detector, and/or filter. In some embodiments of the present invention, the at least one processor is configured to process the detected energy response signal and produce an extracted energy response signal. Valencell at [0007] In some embodiments of the present invention, the energy emitter emits pulsed or modulated energy. Valencell at [0008] In some embodiments of the present invention, the energy emitter comprises at least one optical emitter, and the detector comprises at least one optical detector. Exemplary optical emitters include, but are not limited to, laser diodes (LDs), light-emitting diodes (LEDs), and organic light-emitting diodes (OLEDs). Exemplary optical detectors include, but are not limited to, photodetectors, photodiodes, phototransistors, photoactive resistors, photomultiplier tubes, photomultiplier diodes, photodetector modules, and the like. Valencell at [0009] According to some embodiments of the present invention, a wearable monitoring apparatus includes a substrate configured to be attached to a body of a subject, and a sensor module attached to the substrate. The substrate may be configured to surround a portion of a body, and may be flexible. For example, the substrate may be a wristband, armband, legband, neckband, waistband, ankleband, footband, handband, ringband, headband, etc. In other embodiments, the substrate is configured to be adhesively attached to the body of the subject, similar to a bandage. Valencell at [0043]

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	The detectors that may be incorporated into headsets, earbuds, and/or substrates (e.g., wristbands, armbands, legbands, neckbands, waistbands, anklebands, footbands, handbands, ringbands, headbands, etc.) according to some embodiments of the present invention, may be configured to detect and/or measure one or more of the following types of physiological information/conditions: heart rate, pulse rate, breathing rate, blood flow, VO2, VO2max, heartbeat signatures, cardio-pulmonary health, organ health, metabolism, electrolyte type and/or concentration, physical activity, caloric intake, caloric metabolism, blood metabolite levels or ratios, blood pH level, physical and/or psychological stress levels and/or stress level indicators, drug dosage and/or dosimetry, physiological drug reactions, drug chemistry, biochemistry, position and/or balance, body strain, neurological functioning, brain activity, brain waves, blood pressure, cranial pressure, hydration level, auscultatory information, auscultatory signals associated with pregnancy, physiological response to infection, skin and/or core body temperature, eye muscle movement, blood volume, inhaled and/or exhaled breath volume, physical exertion, exhaled breath physical and/or chemical composition, the presence and/or identity and/or concentration of viruses and/or bacteria, foreign matter in the body, internal toxins, heavy metals in the body, anxiety, fertility, ovulation, sex hormones, psychological mood, sleep patterns, hunger and/or thirst, hormone type and/or concentration, cholesterol, lipids, blood panel, bone density, organ and/or body weight, reflex response, sexual arousal, mental and/or physical alertness, sleepiness, auscultatory information, response to external stimuli, swallowing volume, swallowing rate, sickness, voice characteristics, voice tone, voice pitch, voice volume, vital signs, head tilt, allergic reactions, inflammation response, auto-immune response, mutagenic response, DNA, proteins, protein levels in the blood, water content of the blood, pheromones, internal body sounds, digestive system functioning, cellular regeneration response, healing response, stem cell regeneration response, etc Valencell at [0050] The human ear is an ideal location for wearable health and environmental monitors. The ear is a relatively immobile platform that does not obstruct a person's movement or vision. Headsets located at an ear have, for example, access to the inner-ear canal and tympanic membrane (for measuring core body temperature), muscle tissue (for monitoring muscle tension), the pinna and earlobe (for monitoring blood gas levels), the region behind the ear (for measuring skin temperature and galvanic skin response), and the internal carotid artery (for measuring cardiopulmonary functioning), etc. The ear is also at or near the point of exposure to: environmental breathable toxicants of interest (volatile organic compounds, pollution, etc.); noise pollution experienced by the ear; and lighting conditions for the eye. Furthermore,

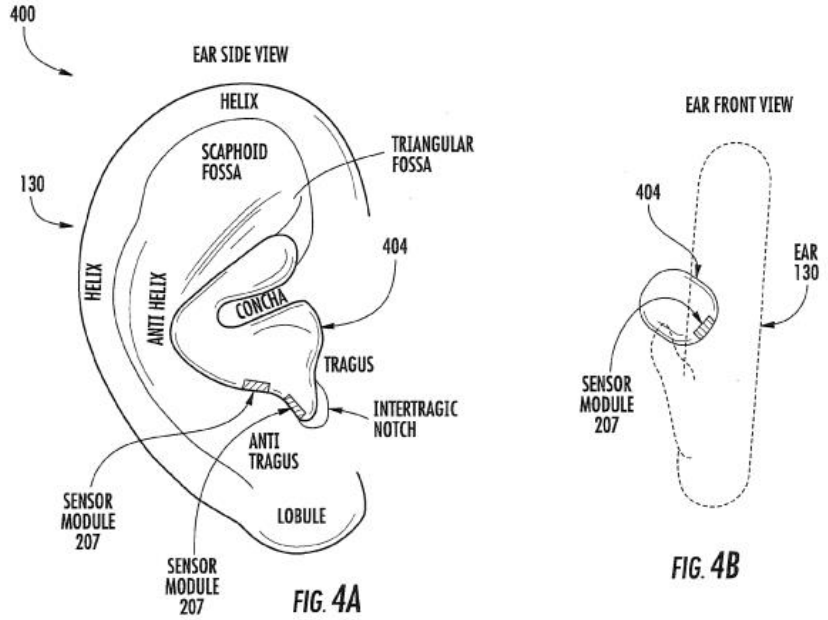
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	as the ear canal is naturally designed for transmitting acoustical energy, the ear provides a good location for monitoring internal sounds, such as heartbeat, breathing rate, and mouth motion. Wireless, Bluetooth®-enabled, and/or other personal communication headsets may be configured to incorporate physiological and/or environmental sensors, according to some embodiments of the present invention. As a specific example, Bluetooth® headsets are typically lightweight, unobtrusive devices that have become widely accepted socially. Moreover, Bluetooth® headsets are cost effective, easy to use, and are often worn by users for most of their waking hours while attending or waiting for cell phone calls. Bluetooth® headsets configured according to embodiments of the present invention are advantageous because they provide a function for the user beyond health monitoring, such as personal communication and multimedia applications, thereby encouraging user compliance. Exemplary physiological and environmental sensors that may be incorporated into a Bluetooth® or other type of headsets include, but are not limited to accelerometers, auscultatory sensors, pressure sensors, humidity sensors, color sensors, light intensity sensors, pressure sensors, etc. Valencell at [00104] FIG. 1 illustrates an interference filtering apparatus/method 100, according to some embodiments of the present invention. A medium 130, preferably physiological material of a living subject, comprises at least one target region of interest 120 which is interrogated by energy 110, preferably modulated energy, such as pulsed energy, generated by an energy emitter 102. A pulsed driving circuit 101 is used to drive at least one energy emitter 102 at one or more pulsed frequencies to interrogate at least one target region of at least one medium 130 with the pulsed energy 110. The energy may be in the form of electromagnetic, acoustical, mechanical, nuclear, electrical, magnetic, thermal, or other forms of energy, but typically optical energy from the electromagnetic spectrum. The energy reaching the medium 130 can interact with the medium to generate at least one energy response signal 111, such as an optical scatter signal 111 between emitted optical energy 110 and the medium 130. The energy response 111 caused by this interaction is detected by at least one detector 103, configured to detect energy in the forms described above, but typically in the form of optical energy scattered from the medium 130. A motion/position sensor 104 may be configured to measure movement, positional changes, or inertial changes in the vicinity of the medium 130. The outputs of the detector 103 may be sent to at least one analog-to-digital convertor (ADC) 105 and the digitized output may be sent to at least one interference filter 106, which is configured to remove the effects of time-varying environmental interference 140 from the signal output of the detector 103. At least one motion/position sensor 104 may be incorporated in the interference filtering method 100 to provide a reference signal for removing the effects of motion

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	from the extracted energy response signal 111 to produce a desired signal 109. For example, the output of the interference filter 106 may be further processed by signal extraction filter 107 to extract accurate information from the medium 130, and this signal extraction filter 107 may utilize the output of the motion/position sensor 104 to remove motion artifacts from the desired signal (the extracted energy response signal) 109. At least one signal processor (not shown) may be used to control the operations of the energy emitter 102, detector 103, filter 106, and/or other components of the interference filtering method 100. Valencell at [0107]  FIG. 1 Valencell at Fig.1 In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region

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	130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108]

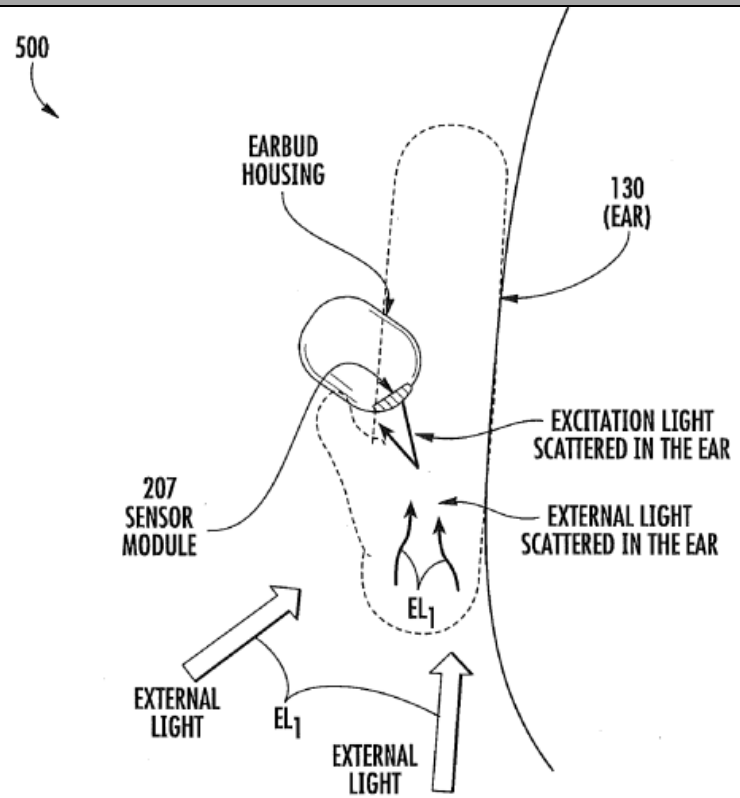
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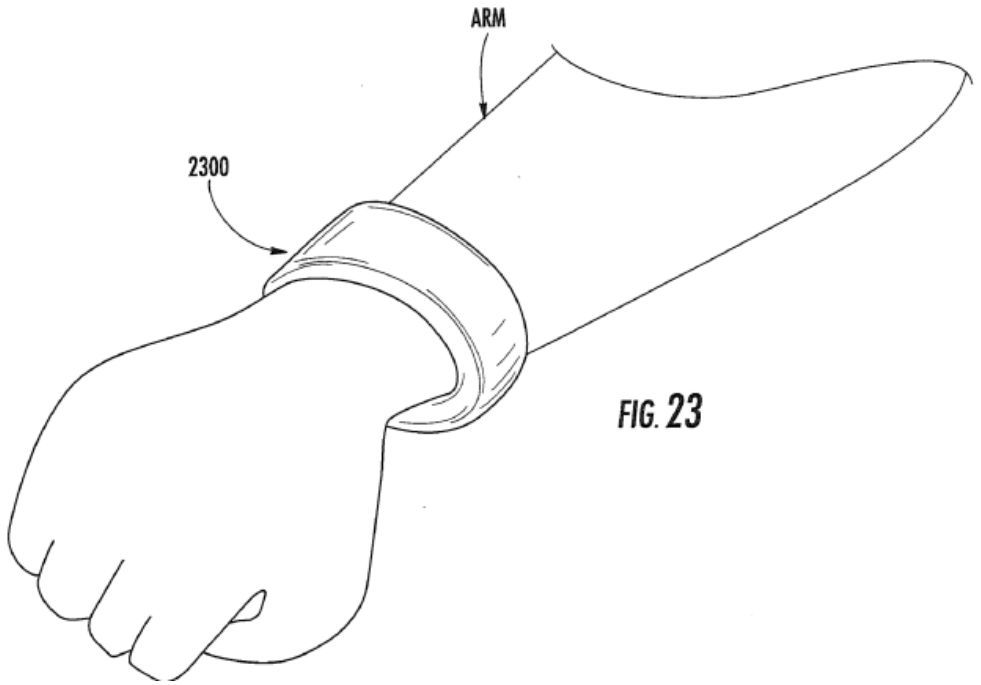
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	 Valencell at fig. 4a and 4b. Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-

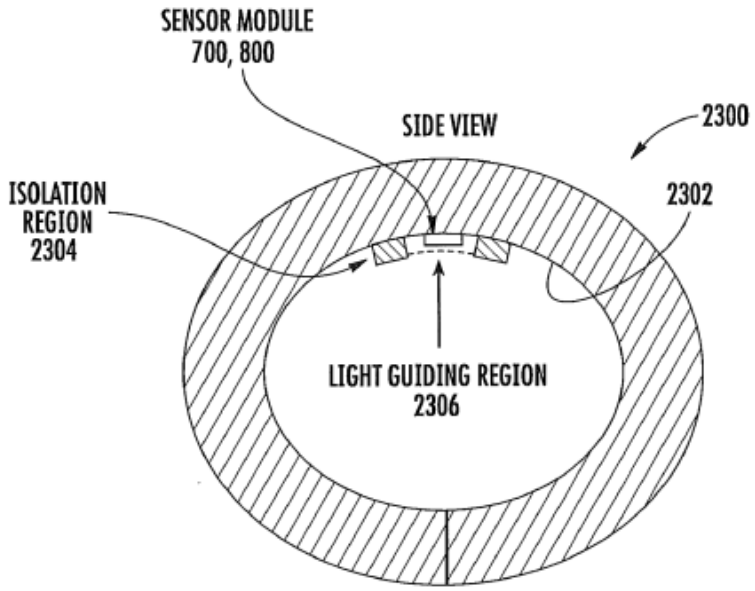
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	detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109] In real-world environments, the energy response signal 111 collected by a wearable sensor module 207 may be corrupted by time-varying environmental interference 140 (FIG. 1). Moreover, the energy response signal 111 may be even further corrupted by motion of the subject in a time-varying environment. For example, the motion caused by running may cause motion with respect to the emitter 102, detector 103, and medium 130 (in this case tissue of the subject), and this motion may cause an unwanted signal on the detector 103. Moreover, the time-varying environmental interference 140 (FIG. 1) may be caused by, or exacerbated by, the motion of the subject. A specific example of time-varying interference in a real-world environment 300 is summarized in FIG. 3. In FIG. 3, the runner is wearing an audio headset H containing biometric monitoring technology, such as Valencell's Healthset® brand technology (Valencell, Inc., Raleigh, N.C.), where at least one photoplethysmography sensor module 207 (FIG. 2) is included within a biometric audio earbud 404 as shown in FIG. 4. The sensor module 207 may contain at least one optical emitter 102, at least one optical detector 103, and at least one processor to measure heart rate, respiration rate, pulse pressure, motion, and/or other physiological conditions near the ear region 130 of the subject. These types of measurements may be achieved by detecting the optical scatter response 111 from the ear region as summarized in FIG. 2. However, direct sunlight SL1, indirect sunlight SL2 and/or artificial light AL1 from the environment may pass into the audio headset H. Time-varying sunlight SL1, SL2 and artificial ambient light AL1 may impart time-varying optical interference 140 on the optical detector 103 embedded within the audio headset H. For example, a time-varying interference signal 140 (FIG. 1) from environmental light may impart

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	substantial artifacts on an energy response signal 111 (FIG. 1) in many real life scenarios, such as when clouds pass through the sky, when a subject runs through shadows, when a subject runs to/from an artificial light source, and/or various thereof. These time-varying artifacts may be difficult to distinguish from the desired time-varying signals associated with time-varying physiological conditions. For example, the interference frequencies associated with a time-varying change in shadows, or the harmonics of these interference frequencies, may correspond with at least one signal frequency associated with footsteps, respiration, or heart rate, and the optical energy response 111 may contain convoluted information comprising interference signals and desired physiological signals. Valencell at [0110]

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	 FIG. 5 Valencell at Fig. 5 Referring to FIGS. 23-29, an exemplary wristband monitoring apparatus 2300 is illustrated. The wristband 2300 houses a power source, circuitry, a sensor module, and electronics as described above with respect to the various earbud embodiments. As illustrated in FIG. 24, a sensor module 700, 800 is positioned on the inside surface 2302 of the wristband 2300. The sensor module 700, 800 may include an isolation region 2304 that is configured to keep the sensor module 700, 800 stable with respect to the subject's wrist during use so as to reduce motion artifacts. The isolation region may be constructed out

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	of any sturdy material, but for comfort, a foamy and/or flexible sturdy material may be utilized. Furthermore, the isolation region 2304 may further shield against environmental interference such as sunlight, external temperature, wind, and the like. Valencell at [0151]  Valencell at fig. 23.

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	 FIG. 24 Valencell at fig. 24. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b]. the light source configured to increase signal-to-noise ratio by	LeBoeuf disclose or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample.

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increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	The term "modulated energy", as used herein, refers to energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc.) that is emitted in pulses and/or that is emitted such that the amplitude, frequency, phase, or intensity is varied. A pulsed energy source modulates by effectively multiplying by a waveform that is a periodic sequence of zeros and ones. Valencell at [0097] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively

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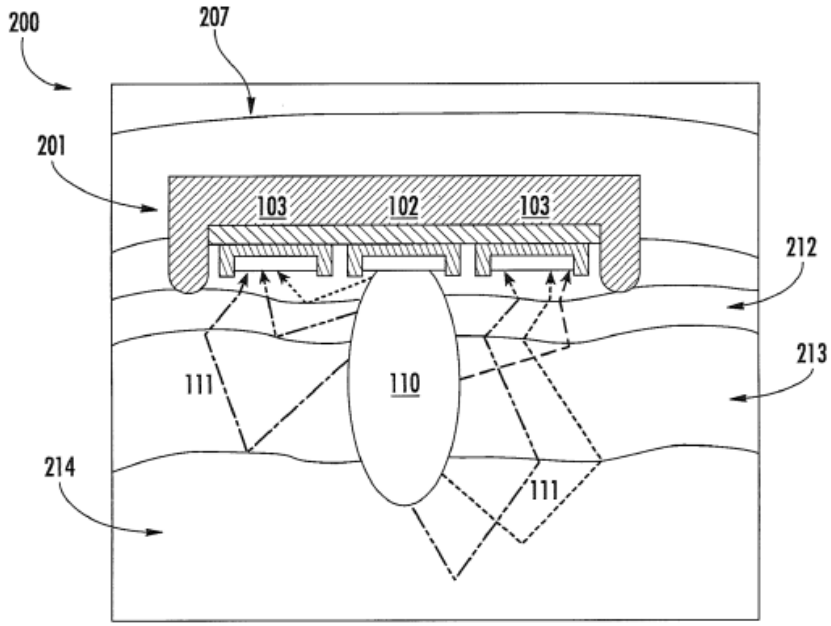
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	removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] In some embodiments of the present invention, an additional optical filter (e.g., 710, FIGS. 7 and 8) may be utilized that serves (or also serves) as an attenuation filter, such as a "neutral density filter", gelatin filter, opaque material, or other optical attenuation filter or filtering materials. In one embodiment, an optical filter 710 may serve as both an optical wavelength filter and an attenuation filter. Because sunlight is so powerful, it may be beneficial to reduce sunlight interference as much as possible, even if that means also reducing the amount of optical scatter 111 (FIG. 1) of interest from the medium 130 (FIG. 1). To offset this unwanted reduction in optical scatter 111, the intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight. Valencell at [0123] An exemplary filter processes samples 1910, the off/on samples 1920/1930 respectively, taken from a digitized physiological sensor signal 1911 generated by a detector (e.g., 103, FIG. 1) as shown in FIGS. 19A-19B. A pulsed emitter (e.g., 102, FIG. 1) generates a pulsed beam of light such that some samples 1920 represent signal 1911 from a detector with the emitter turned off and other samples 1930 represent signal 1911 from the detector with the emitter turned on. Both types of samples 1920 and 1930 may contain environmental noise from environmental interferants, but only emitter-on samples 1930 contain physiological information generated by the emitter energy. The digitized samples taken from detector signal 1911, provided by an ADC (e.g., 105, FIG. 1), are processed by an interference filter (e.g., 106, FIG. 1) and the output of the interference filter may be directed for further processing (represented by 107, FIG. 1). Valencell at [0137]

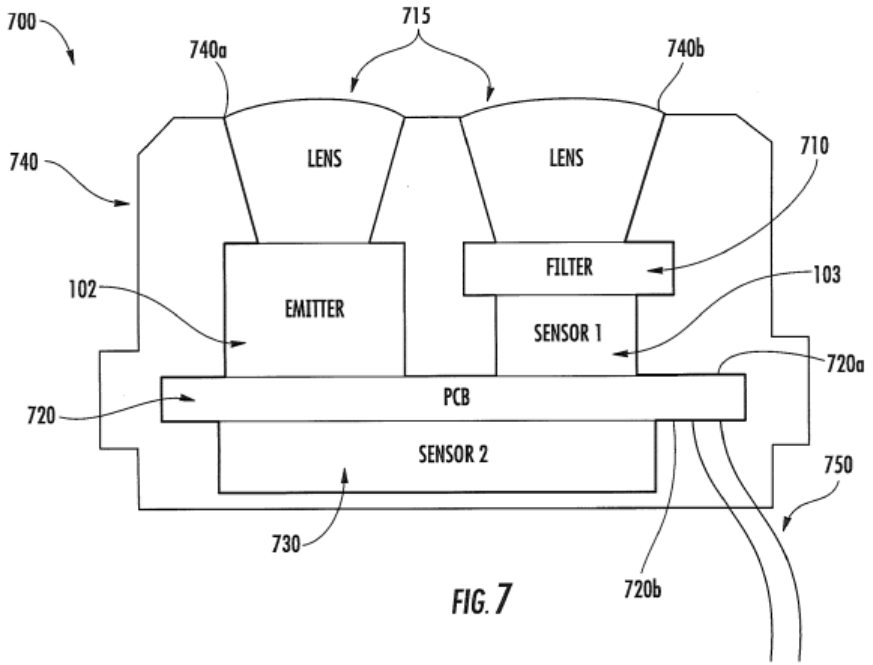
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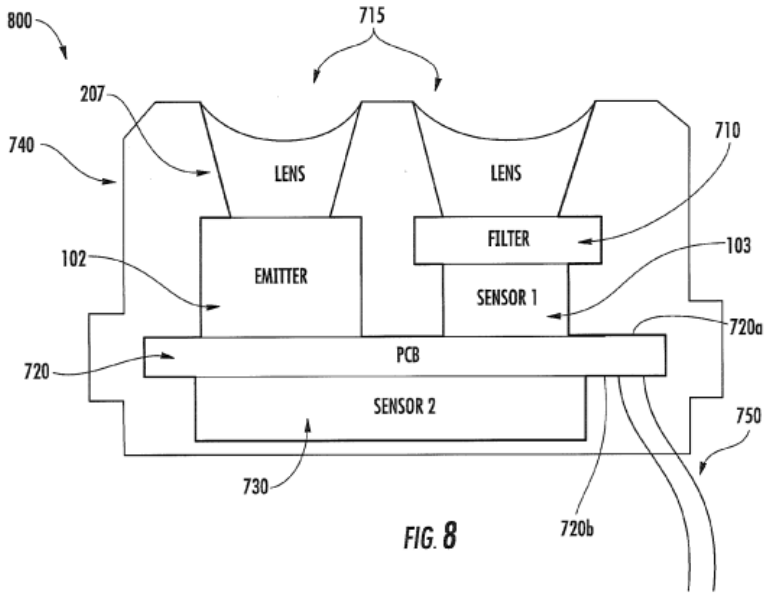
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	These operations are summarized in FIG. 18, which is a flow chart of operations for removing environmental noise from a sensor signal via an interference filter, according to some embodiments of the present invention. At Block 1800, at least one ADC sample is read when the emitter is on. At Block 1802, at least one ADC sample is read when the emitter is off. At Block 1804, relevant on/off samples are input to an interference filter. At Block 1806, at least one sample from the interference filter is output for further processing. Valencell at [0138] An interference filter (e.g., 106, FIG. 1) utilized according to embodiments of the present invention, may vary in nature and complexity. For example, an interference filter may subtract temporally neighboring emitter-off samples 1920 (FIG. 19A) from temporally neighboring emitter-on samples 1930 (FIG. 19A) and output a "subtraction" signal for further processing. In this embodiment, the subtraction may involve subtracting temporally neighboring on/off samples, averaging temporally neighboring on samples and averaging temporally neighboring off samples and then subtracting the average off samples from the average on samples, or by other approaches to subtracting off signals 1920 from on signals 1930. When choosing a subtraction approach, it is important to consider the emitter pulsing frequency and sampling approach. For example, choosing a frequency that is too low may result in unsatisfactory subtraction, as the dynamic environmental conditions between off-states 1920 and on-states 1930 may be too abrupt for the sampling frequency, such that the physiological state of interest is not properly characterized by the interference filter. Thus, the sampling frequency may need to be much higher than the Nyquist frequency required for characterizing the signal in a stationary environment. As a specific example, if an interference filter (e.g., 106, FIG. 1) is being used to remove sunlight interference (e.g., SL1, SL2, FIG. 3), from a photoplethysmogram 1911 (FIGS. 19A, 19B), and if the desired processed output from the final filtering is heart rate, then the Nyquist criteria for pulsing the emitter may be 2×fmax, where fmax is the maximum heart rate of interest, which is likely to be somewhere around 200 beats/minute (BPM) or 3.33 Hz. Valencell at [0139] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Valencell discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. In some embodiments of the present invention, the sensor module includes a lens positioned above at least one of the optical emitter and filter. The lens may include respective first and second portions configured to matingly engage respective first and second apertures in the light-opaque material. Valencell at [0016] In other embodiments of the present invention, a first lens is positioned within the first aperture and is in optical communication with the optical emitter, and a second lens is positioned within the second aperture and is in optical communication with the optical detector. The first lens focuses light emitted by the optical emitter and the second lens focuses light toward the optical detector. Valencell at [0017] In some embodiments of the present invention, the at least one sensor module include a lens positioned above at least one of the optical emitter and filter. The lens may include respective first and second portions configured to matingly engage respective first and second apertures in the light-opaque material. Valencell at [0022] In other embodiments of the present invention, a first lens is positioned within the first aperture and is in optical communication with the optical emitter, and a second lens is positioned within the second aperture and is in optical communication with the optical detector. The first lens focuses light emitted by the optical emitter and the second lens focuses light toward the optical detector. Valencell at [0023]

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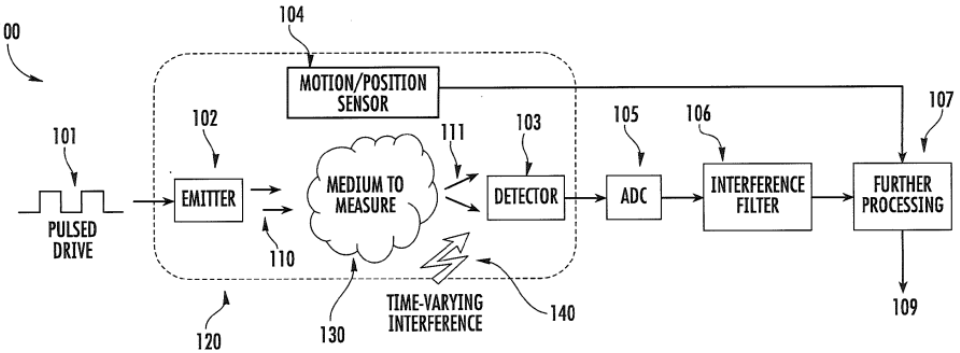
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	In some embodiments, multiple emitters, detectors, lenses, light guides, and/or diffusion regions may be employed within a sensor module. Valencell at [0038] FIG. 2 illustrates a multi-wavelength reflection-mode pulse oximetry apparatus that may be utilized in accordance with some embodiments of the present invention Valencell at [0054]  FIG. 2 Valencell at fig. 2. FIG. 7 illustrates a sensor module with a convex lens configuration, according to some embodiments of the present invention.

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	Valencell at [0060]  FIG. 7 Valencell at fig. 7. FIG. 8 illustrates a sensor module with a concave lens configuration, according to some embodiments of the present invention. Valencell at [0061]

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	 FIG. 8 Valencell at fig. 8. In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical

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	detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-

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	detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109]  FIG. 1 Valencell at Fig. 1 According to some embodiments of the present invention, a sensor module 700 with an overmolded design, as shown in FIG. 7, may be employed to remedy the problems associated with sunlight leaking towards the optical detector 103. In this design, an overmold layer 740 surrounds the components of the sensor module 700 to prevent light leakage into any spot along the periphery of the sensor module 700.

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	The overmold layer 740 comprises a light-opaque material surrounding the optical emitter 102 and optical detector 103 such that the optical emitter 102 and optical detector 103 are not in direct optical communication with each other. The light-opaque material of the overmold layer 740 may include a first aperture 740 a in communication with the optical emitter 102, and a second aperture 740 b in communication with the optical detector 103. Thus, the only device regions having access to outside light may be the regions of the optical emitter 102 and detector 103, but these may be covered by at least one optical filter 710 tuned to a wavelength region of interest. If utilized, the wavelength pass-band of an optical filter covering the emitter 102 should be tuned to the emitter wavelength band so that all other light is blocked. If utilized, the wavelength pass-band of the optical filter 710 covering the detector 103 should be tuned to at least one wavelength band associated with the optical scatter 111 (FIG. 1) of interest from the medium 130 (FIG. 1) so that all other light is blocked. Valencell at [0116] In some embodiments of the present invention, an optical filter for the emitter 102 and detector 103 may be the same filter, such as may be the case for optical scatter 111 (FIG. 1) detection by the detector 103 where all light other than the emitter light of interest may be blocked by the filter 710. According to some embodiments of the present invention, the optical filter 710 covering the detector 103 is configured to block unwanted sunlight but still allow wavelengths from the optical emitter 102 to pass therethrough. In some embodiments of the present invention, the optical filter 710 over the detector 103 is configured to pass wavelengths centered around 930 nm, and the optical emitter 102 is configured to emit wavelengths centered around 930 nm. According to some embodiments of the present invention, the optical filter 710 may have a surface area greater than a surface area of the optical detector 103. In some embodiments of the present invention, the optical filter 710 overlies the optical detector 103 such that a periphery of the optical filter 710 overlaps a periphery of the optical detector 103, as shown in FIG. 7 and FIG. 8. Valencell at [0117] To guide light from the optical emitter 102 towards the skin 130 of a subject and to direct light from the skin 130 to the optical detector 103, lenses 715 may be utilized, as illustrated in FIG. 7. The lenses 715 may be physically separated lenses (as shown in FIGS. 7 and 8) or combined or conjoined lenses. In some embodiments of the present invention, there is no optical coupling between the emitter lens 715 and detector lens 715. For this reason, a barrier region may be incorporated in the case where the lenses

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	are combined or conjoined. Separated lenses may be isolated by at least one light opaque barrier region greater than 50 μm in thickness. Light opaque plastic, rubber, metal, or polymeric material are a few examples of good choices for the light opaque region. The optical lenses 715 may be designed for the desired optical coupling between the skin/blood vessel region and the emitter 102 or detector 103. For example, a convex lens design (such as that of FIG. 7) placed over the emitter 102 may focus light onto the skin, and a concave lens design (such as that of FIG. 8) placed over the emitter 102 may diverge light over the skin region. In the other direction, a convex lens design placed over the detector 103 may capture more light over a broader region and direct that light towards the detector 103, whereas a concave lens may collimate light towards the detector 103. Valencell at [0118] The optical lenses 715 may be separate from the overmold layer 740 or may be part of the overmold layer 740. For example, the overmold layer 740 may be comprised of material that is transparent to light 110 (FIG. 1) coming from the emitter 102. In such case, the lenses 715 may integral with the overmold layer 740. In other cases, the optical lenses 715 may be comprised of different material than the overmold layer 740, such that the lenses 715 may fit within the overmold layer 740 and be matingly engaged with the overmold layer 740. Valencell at [0119] Another benefit of the overmolded design of FIGS. 7 and 8 is that it may also provide resistance to water, humidity, sweat, wind, and other environmental interferants. For example, an overmolded plastic design around the emitters 102 and detectors 103, combined with overmolded or glued lenses 715, may at least partially encapsulate the emitters 102 and detectors 103 and hence at least partially isolate these devices from the environment. Valencell at [0121]. In some embodiments of the present invention, an additional optical filter (e.g., 710, FIGS. 7 and 8) may be utilized that serves (or also serves) as an attenuation filter, such as a "neutral density filter", gelatin filter, opaque material, or other optical attenuation filter or filtering materials. In one embodiment, an optical filter 710 may serve as both an optical wavelength filter and an attenuation filter. Because sunlight is so powerful, it may be beneficial to reduce sunlight interference as much as possible, even if that

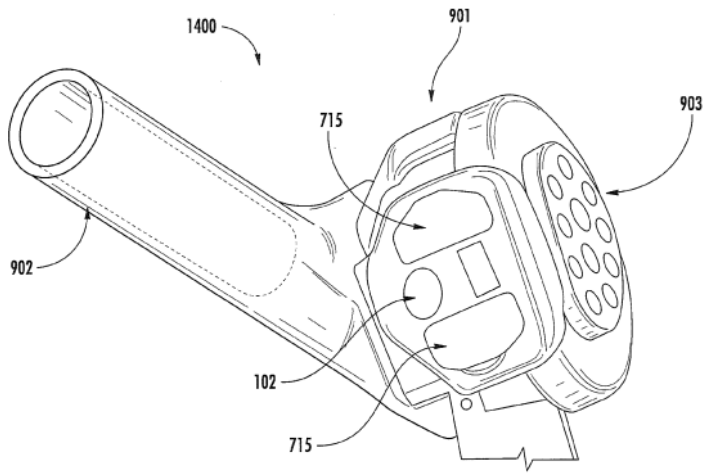
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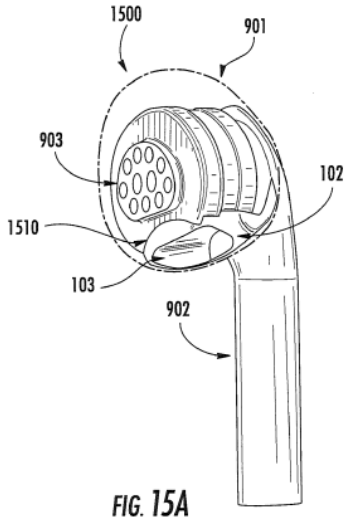
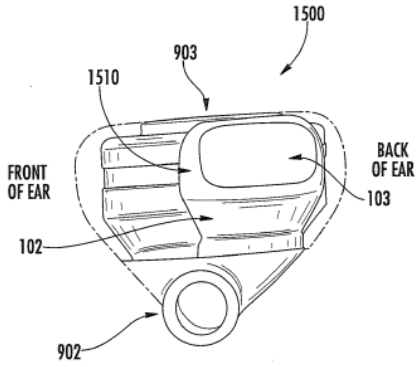
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	means also reducing the amount of optical scatter 111 (FIG. 1) of interest from the medium 130 (FIG. 1). To offset this unwanted reduction in optical scatter 111, the intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight. Valencell at [0123]. The angling of the sensor modules 700, 800 (FIGS. 7 and 8) within the earbud housing 901 may be designed to direct light towards the ear and detect light from the ear while rejecting as much environmental light (such as sunlight) as possible. As shown in FIG. 10, angling the normal "N" of the lens 715 between the perpendicular lines "A" & "B", where "A" is perpendicular to earth ground and "B" is parallel to earth ground, would help achieve this goal. Phrased another way, the angle "θN" between "N" and "A" or "N" and "B" would preferably be less than 90°. The lens 715 placement and angle does not obstruct the audio cavity between the speaker 910 and the earbud housing opening(s) 903, which helps couple light to the ear canal. For this reason, in some cases, angle "θN" approximating 45° may be utilized for limiting the sensor module 700 exposure to outside light while also limiting the obstruction of the audio cavity by the sensor module 700. Valencell at [0124]. The lenses 715 described herein may be comprised of any material that is at least partially transparent to the wavelengths of light generated by the emitter 102 and/or the desired wavelengths of light detected by the detector 103. In some embodiments of the present invention, the lenses 715 are completely transparent to the light of interest, but in other embodiments of the present invention the lenses 715 may be configured to diffuse, attenuate, disperse, or redistribute light uniformly across the lens. For example, a lens 715 incorporating diffusing material, placed over the emitter 102, may help spread more light from the emitter more uniformly across the area of the lens such that a broader physiological region may be excited by optical radiation. Similarly, a diffusing lens configuration placed over the detector 103 may help detect light from a broader area of the body and direct that light towards the detector 103. Some plastic materials contain scattering centers or materials that tend to scatter light. For example, silicones may be used to diffuse light in a lens. Partially opaque lenses may also be used to provide diffusion or internal scattering of light within a lens. Additionally, roughened surfaces, such as roughened plastic or glass, may encourage diffuse optical scatter without greatly attenuating the intensity of light. Other

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	methods of creating optical diffusion or scattering in light-guiding materials such as lenses may be utilized. Valencell at [0125]. At least part of the earbud housing 901 (FIG. 11) or sensor module 700 (FIG. 11) may comprise a soft material which deforms when inserted within the ear and that facilitates retention of the earbud within the ear. For example, the shape of earbud housing 901 shown in FIG. 11 may facilitate retention of the earbud 1100 within the ear because it may be shaped to mate or engage with the concha or outer ear canal of the ear. Furthermore, if part of the earbud 1100 comprises a soft material, such as soft plastic, polymer, silicone, or rubber, the material may deform when the earbud 1100 is inserted within the ear such that this part of the earbud 1100 mates or engages with the ear. The sensor modules of FIGS. 7 and 8 may be integrated within the earbud housing 901, such that at least a portion of the housing 901 may comprise optically transmissive material to allow light to move from the emitter 102 to the ear region or from the ear region to the detector 103. The soft deforming material may be adjacent to the optically transmissive material or may comprise at least part of the optically transmissive material itself. For example, the lenses 715 of FIG. 9 may be comprised of optically transparent material that is also soft, such as silicone or transparent plastic, polymer, rubber, or the like. In another embodiment, a second layer of soft, yet transparent, material may cover the lenses 715. Valencell at [0128]. An exemplary overmolding configuration of a sensor module 1201 is illustrated in FIGS. 12A-12C. The sensor module 1201 is shown without an emitter, detector, or lenses, but rather with recesses/apertures 1202 showing where lenses may be located. Exemplary dimensions are also presented in FIG. 12. In some embodiments of the present invention, dimensions are on the order of millimeters or less, such that the sensor module 1201 can fit within a small-sized earbud without obstructing, or minimally obstructing, the audio cavity. In the illustrated embodiment, an emitter and detector to be used with the sensor module 1201 can be arranged in a line that is parallel with the antitragus. This arrangement is illustrated in FIGS. 13A-13C. However, embodiments of the present invention are not limited to any particular set of dimensions or to any shape or configuration. Valencell at [0129].

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	FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, collecting light at different wavelengths, and processing these signals collectively, can be used to generate assessments of blood gas levels, such as blood oxygen (SpO2) and carbon dioxide (SpCO2), blood hemoglobin types and levels, or other blood constituents and their respective concentration levels. Multiple wavelengths may be generated by a signal multiwavelength optical emitter, multiple optical emitters, optically filtered optical emitters, or the like. In such case, multiple optical emitters 102 may be located between the two optical filters 715. Valencell at [0130].

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	 FIG. 14 Valencell at fig. 14. FIGS. 15A-15B show a multi-detector earbud 1500, where two separate optical detectors 103 are covered by two separate optical lenses, at least one optical emitter is covered by at least one optical lens, and where the emitter 102 and detector 103 configuration is oriented perpendicularly to the antitragus (as that shown in FIG. 11). In FIGS. 15A-15B, the optical detectors 103, emitters 102, and lenses are not readily visible as they are surrounded, at least in part, by an optical coupling area 1510. The lenses (not shown) may cover each separate emitter 102 and detector 103 as shown in FIGS. 7 and 8. Note that in this configuration, the emitter- detector module 700, 800 of FIGS. 7 and 8 is oriented towards the back of the ear (near the back of the head). This arrangement may serve two purposes: 1) sunlight may be further blocked from reaching the detectors 103, as the back of the ear may serve as a shield and 2) there may be less motion artifacts convoluting the desired blood flow signals, as the detectors 103 may be oriented away from mouth-motion-prone areas located near the front of the ear. Another feature of the earbud 1500 of FIGS. 15A and 15B is that an optical coupling area 1510 is located on top of the optical emitter 102 and surrounding (but not covering) the optical detector 103. This optical coupling area 1510 may help diffuse, scatter, and/or guide light from the optical emitter to couple with a broader area of the ear region. Having a broader coupling area may help excite more regions of the ear with optical energy 110 (FIG. 1) and reduce the chance that the optical energy may miss important blood vessels, which may

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	be located in different regions for different persons. Thus, such a design may promote a more universal design for a biometric earbud. Without an optical coupling area 1510, the optical energy 110 from the optical emitter(s) 102 may miss blood vessels in different persons due to physiological differences that may exist between different people. Alternatively, the optical coupling area 1510 may be configured to cover the optical detector 103 area and not the optical emitter 102 area, such that more light is guided from different regions of the ear and coupled into the detector 103. Alternatively, a plurality of optical diffusion areas may be configured to cover the emitter 102 and detector 103 separately. Valencell at [0131].  FIG. 15A  FIG. 15B Valencell at fig. 15a and 15b. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d]. the wearable measurement device further comprising a receiver configured to:	Valencell discloses or renders obvious the wearable measurement device further comprising a receiver. FIG. 1 illustrates an interference filtering apparatus/method 100, according to some embodiments of the present invention. A medium 130, preferably physiological material of a living subject, comprises at least one target region of interest 120 which is interrogated by energy 110, preferably modulated energy, such as pulsed energy, generated by an energy emitter 102. A pulsed driving circuit 101 is used to drive at least one energy emitter 102 at one or more pulsed frequencies to interrogate at least one target region of at least one medium 130 with the pulsed energy 110. The energy may be in the form of electromagnetic, acoustical, mechanical, nuclear, electrical, magnetic, thermal, or other forms of energy, but typically optical energy from the electromagnetic spectrum. The energy reaching the medium 130 can interact with the medium to generate at least one energy response signal 111, such as an optical scatter signal 111 between emitted optical energy 110 and the medium 130. The energy response 111 caused by this interaction is detected by at least one detector 103, configured to detect energy in the forms described above, but typically in the form of optical energy scattered from the medium 130. A motion/position sensor 104 may be configured to measure movement, positional changes, or inertial changes in the vicinity of the medium 130. The outputs of the detector 103 may be sent to at least one analog-to-digital convertor (ADC) 105 and the digitized output may be sent to at least one interference filter 106, which is configured to remove the effects of time-varying environmental interference 140 from the signal output of the detector 103. At least one motion/position sensor 104 may be incorporated in the interference filtering method 100 to provide a reference signal for removing the effects of motion from the extracted energy response signal 111 to produce a desired signal 109. For example, the output of the interference filter 106 may be further processed by signal extraction filter 107 to extract accurate information from the medium 130, and this signal extraction filter 107 may utilize the output of the motion/position sensor 104 to remove motion artifacts from the desired signal (the extracted energy response signal) 109. At least one signal processor (not shown) may be used to control the operations of the energy emitter 102, detector 103, filter 106, and/or other components of the interference filtering method 100. Valencell at [0107]

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	In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108]

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	Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample	Valencell discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. Apparatus and methods for attenuating environmental interference are described. A wearable monitoring apparatus includes a housing configured to be attached to the body of a subject and a sensor module that includes an energy emitter that directs energy at a target region of the subject, a detector that detects an energy response signal—or physiological condition—from the subject, a filter that removes time-varying environmental interference from the energy response signal, and at least one processor that controls operations of the energy emitter, detector, and filter. Valencell at Abstract. FIG. 1 illustrates an interference filtering apparatus/method 100, according to some embodiments of the present invention. A medium 130, preferably physiological material of a living subject, comprises at least one target region of interest 120 which is interrogated by energy 110, preferably modulated energy, such as pulsed energy, generated by an energy emitter 102. A pulsed driving circuit 101 is used to drive at least one energy emitter 102 at one or more pulsed frequencies to interrogate at least one target region of at least one medium 130 with the pulsed energy 110. The energy may be in the form of electromagnetic, acoustical, mechanical, nuclear, electrical, magnetic, thermal, or other forms of energy, but typically optical energy from the electromagnetic spectrum. The energy reaching the medium 130 can interact with the medium to generate at least one energy response signal 111, such as an optical scatter signal 111 between emitted optical energy 110 and the medium 130. The energy response 111 caused by this interaction is detected by at least one detector 103, configured to detect energy in the forms described above, but typically in the form of optical energy scattered from the medium 130. A motion/position sensor 104 may be configured to measure movement, positional changes, or inertial changes in the vicinity of the medium 130. The outputs of the detector 103 may be sent to at least one analog-to-digital convertor (ADC) 105 and the digitized output may be sent to at least one interference filter 106, which is configured to remove the effects of time-varying environmental interference 140 from the signal output of the detector 103. At least one motion/position sensor 104 may be incorporated in the interference filtering method 100 to provide a reference signal for removing the effects of motion from the extracted energy response signal 111 to produce a desired signal 109. For example, the output

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	of the interference filter 106 may be further processed by signal extraction filter 107 to extract accurate information from the medium 130, and this signal extraction filter 107 may utilize the output of the motion/position sensor 104 to remove motion artifacts from the desired signal (the extracted energy response signal) 109. At least one signal processor (not shown) may be used to control the operations of the energy emitter 102, detector 103, filter 106, and/or other components of the interference filtering method 100. Valencell at [0107] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact

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	reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject.

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	Valencell at [0109] An exemplary filter processes samples 1910, the off/on samples 1920/1930 respectively, taken from a digitized physiological sensor signal 1911 generated by a detector (e.g., 103, FIG. 1) as shown in FIGS. 19A-19B. A pulsed emitter (e.g., 102, FIG. 1) generates a pulsed beam of light such that some samples 1920 represent signal 1911 from a detector with the emitter turned off and other samples 1930 represent signal 1911 from the detector with the emitter turned on. Both types of samples 1920 and 1930 may contain environmental noise from environmental interferants, but only emitter-on samples 1930 contain physiological information generated by the emitter energy. The digitized samples taken from detector signal 1911, provided by an ADC (e.g., 105, FIG. 1), are processed by an interference filter (e.g., 106, FIG. 1) and the output of the interference filter may be directed for further processing (represented by 107, FIG. 1). Valencell at [0137] These operations are summarized in FIG. 18, which is a flow chart of operations for removing environmental noise from a sensor signal via an interference filter, according to some embodiments of the present invention. At Block 1800, at least one ADC sample is read when the emitter is on. At Block 1802, at least one ADC sample is read when the emitter is off. At Block 1804, relevant on/off samples are input to an interference filter. At Block 1806, at least one sample from the interference filter is output for further processing. Valencell at [0138] An interference filter (e.g., 106, FIG. 1) utilized according to embodiments of the present invention, may vary in nature and complexity. For example, an interference filter may subtract temporally neighboring emitter-off samples 1920 (FIG. 19A) from temporally neighboring emitter-on samples 1930 (FIG. 19A) and output a "subtraction" signal for further processing. In this embodiment, the subtraction may involve subtracting temporally neighboring on/off samples, averaging temporally neighboring on samples and averaging temporally neighboring off samples and then subtracting the average off samples from the average on samples, or by other approaches to subtracting off signals 1920 from on signals 1930. When choosing a subtraction approach, it is important to consider the emitter pulsing frequency and sampling approach. For example, choosing a frequency that is too low may result in unsatisfactory subtraction, as

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	the dynamic environmental conditions between off-states 1920 and on-states 1930 may be too abrupt for the sampling frequency, such that the physiological state of interest is not properly characterized by the interference filter. Thus, the sampling frequency may need to be much higher than the Nyquist frequency required for characterizing the signal in a stationary environment. As a specific example, if an interference filter (e.g., 106, FIG. 1) is being used to remove sunlight interference (e.g., SL1, SL2, FIG. 3), from a photoplethysmogram 1911 (FIGS. 19A, 19B), and if the desired processed output from the final filtering is heart rate, then the Nyquist criteria for pulsing the emitter may be 2×fmax, where fmax is the maximum heart rate of interest, which is likely to be somewhere around 200 beats/minute (BPM) or 3.33 Hz. Valencell at [0139] However, a person running through alternating shadows may generate a sunlight interference frequency greater than 10 Hz. In such case, it may be desirable to select a sampling frequency greater than twice the sunlight interference frequency, which in this case would be greater than 20 Hz. Samples that are temporally neighboring (located close to each other in time) may be averaged in this case to help remove noise associated with unintended transients. For example, the off samples 1920 (FIGS. 19A, 19B) that come before, and/or after, a given on sample 1930 (FIGS. 19A, 19B) may be averaged and then that average may be subtracted from the on sample 1930 (or average of the on samples), and this final result may be passed along for further processing. Valencell at [0140] As another example, a batch of data may be defined to consist of: 1) a set number of on/off optical detector samples, for instance 6 interleaved on/off samples, 2) a set number of motion sensor samples, for instance 3 samples (one for each on/off optical sample), and 3) a time delay. The time delay may be adjusted to generate the desired batch rate or batch frequency. The 6 on/off optical samples may be input to a multi-tap filter, for instance an M-tap weighted sum filter, and the output may be defined as 1 output per batch for the interference filter. If the optical on/off samples are extended to fill the whole batch period by "N" samples, then the decimation factor is "N", and the effective sample rate is N*batch rate. The parameters for adjustment in this filter may then be N and M, where M is the number of taps in the filter. The batch rate may be chosen to avoid aliasing of interfering harmonics from the desired physical condition monitored, such as the heart rate. For example, batch rate may be chosen as 10*HRmax, where HRmax is the maximum heart rate to be measured. The batch rate may dominate the MIPS (million

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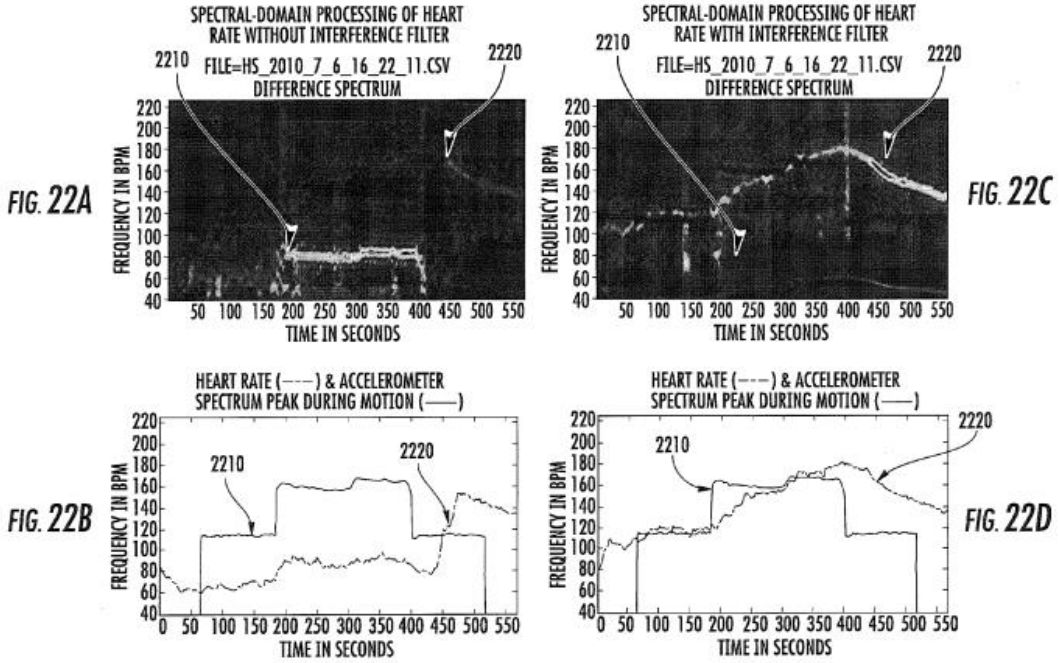
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	instructions per second) used by a signal processor, such as a DSP (digital signal processor), since it affects the spectral transform of the desired output signal. In this filtering embodiment, to minimize aliasing from interfering sunlight-shadow changes on the desired heart rate output signal (especially for running or cycling through shadows), a increasing the N and/or M may be preferred. Valencell at [0141] It should be noted from FIG. 21 that interference filter 2000 may reject more unwanted sunlight than less complex filters. Because the dominant sunlight noise frequencies 2150 may be located at lower frequencies, and because the modulated heart rate signal frequency 2160 may be located at a much higher frequency, most or all of the sunlight noise 2150 may be rejected by the interference filter 2130. Then through demodulation in further-processing (e.g., 107, FIG. 1), the heart rate signal may be returned to the baseband so that real-time heart rate may be extracted. Valencell at [0146] An interference filtering method, according to some embodiments of the present invention, may employ a motion/position sensor (e.g., 104, FIG. 1) to further remove interference from a desired physiological signal (e.g., 109, FIG. 1). For the case of sunlight interference (e.g., 140, FIG. 1) on an earbud sensor module (e.g., 207, FIG. 2), outdoor sunlight may more strongly illuminate an ear and detector 103 in the sensor module 207 than the emitter 102 in the sensor module 207. While an interference filter (e.g., 2130, FIG. 21) may effectively remove the baseband frequencies of this interference, harmonics caused by motion-induced sunlight noise may dominate the digitized signal near the frequencies of the modulated desired information (e.g., 2160, FIG. 21). The step rate of a person running or jogging may be the strongest component of this interference. Moreover, because a person running or jogging may be moving through varying sunlight intensity, the interference signal may be a convolution of motion-coupled-sunlight changes in time. A technique for removing sunlight interference, according to some embodiments of the present invention, utilizes a motion or position sensor (e.g., 104, FIG. 1), such as an inertial sensor, accelerometer, pedometer, gyroscope, microelectromechanical sensor, capacitive sensor, inductive sensor, optical motion sensor, or the like. The step rate may be measured as the peak frequency in the spectrum of the signal coming from motion/position sensor 104 or as the frequency of the spectral peak of the signal coming from the motion/position sensor 104. For example, the processed spectrum may employ differentiation or integration to generate a processed motion/position signal, and the peak frequency of this processed spectrum may be more indicative of the step rate. Harmonics and aliased

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	harmonics of the step rate may determine the frequencies of interference to ignore in the desired-information spectrum. For example, the emitter pulse rate minus eight times the step rate (aliased 8th harmonic) may be the frequency of strong interference in the frequency space of the modulated heart rate (e.g., 2160, FIG. 21), and frequencies within a pre-determined range may be set to zero in the desired-information spectrum. Valencell at [0147] It should be noted that a motion/position sensor (e.g., 104, FIG. 1) utilized in accordance with some embodiments of the present invention may come from a broad range of sensors: inertial sensor, accelerometer, pedometer, gyroscope, microelectromechanical sensor, capacitive sensor, electrical sensor, inductive sensor, optical motion sensor, or the like. This is because many types of sensors may be either intentionally or unintentionally sensitive to motion and/or position. However, in some embodiments of the present invention, a sensor 104 (FIG. 1) and/or processing algorithm are utilized that can identify motion signals from physiological, environmental, or other signals not directly associated with motion. In some embodiments of the present invention, at least one optical detector (e.g., 103, FIG. 1) may also serve as a motion sensor. Motion-related changes in scattered light (e.g., 111, FIG. 1) may be several times greater than blood-flow related changes in scattered light. Thus, the output of at least one detector 103 may be processed with a digital filter, such as a spectral filter, adaptive filter, threshold filter, or the like, to identify only motion-related signals and remove these signals from the desired response (e.g., 109, FIG. 1). Such processing may identify motion-related signals from physiological-related signals. In some embodiments of the present invention, by employing multiple optical detectors (e.g., 102, FIG. 1), motion-related signals may be identified from physiological-related signals by processing signals from the multiple detectors using an algorithm, such as a spectral algorithm. An example of a spectral processing algorithm for identifying motion-related signals, according to some embodiments of the present invention, is to generate a spectral representation of all signals in all detectors (e.g., 102, FIG. 1), identify key frequencies in each signal, and subtract, reduce, or remove all frequencies in common with each detector output. This type of filtering technique may work well because physiological signals may generate similar spectral peaks for all detectors (e.g., 102, FIG. 1) but motion signals may generate dissimilar spectral peaks in at least one detector (e.g., 103, FIG. 1). Another example of processing the detectors (e.g., 102, FIG. 1) to identify and remove motion-related signals is to position at least one detector in a location that does not "see" optical scatter (e.g., 111, FIG. 1) from the body/ear region but instead sees optical scatter from the earbud housing (e.g., 901, FIGS. 9A, 9B) or other material that may move in synchronization with the body. For example, the secondary sensor 730

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	(FIG. 7) may be an optical detector that measures light scattered from the earbud itself; because the sensor 730 may be facing the earbud and not the ear, only light scatter from the earbud may be detected. Valencell at [0148] FIGS. 22A-22D are graphs of a processed heart rate signal output 109 of an earbud module (e.g., earbud module 207, 700, FIGS. 2, 7) employing two different filter configurations, according to some embodiments of the present invention. The graphs illustrated in FIGS. 22A-22D were generated from data collected from a user wearing an earbud (e.g., 404, FIGS. 4A, 4B) during an outdoor run. FIGS. 22A and 22C show relative spectrograms of frequency vs. time, where the strongest spectral signals show the brightest relative intensities. FIGS. 22B and 22D show the estimates of step rate 2210 and heart rate 2220 following further processing 107 to extract the desired frequencies of interest. FIG. 22A shows the spectrogram of the digitized sensor output from an optical detector (e.g., 103, FIG. 1) following the ADC process (e.g., 105, FIG. 1) without employing an interference filter (e.g., 106, FIG. 1). FIG. 22C shows the spectrogram of the same digitized sensor output of FIG. 22A following signal processing via the interference filter 2130 of FIG. 21. FIG. 22A shows a great deal of broadband noise from sunlight, the strongest signal appears to be the step rate signal 2210, and the heart rate spectrum 2220 appears very faint with respect to the step rate signal. In contrast, FIG. 22C shows substantially less broadband noise from sunlight, the strongest signal appears to be the heart rate signal 2220, and the step rate signal 2210 appears very faint with respect to the heart rate signal. Through further filtering (e.g., 107, FIG. 1), the heart rate 2220 and step rate 2210 may be extracted, as shown in FIGS. 22B and 22D. FIG. 22B shows that the estimated heart rate signal 2200 is incorrect and does not match that of the spectrogram illustrated in FIG. 22A. In contrast, FIG. 22D shows that the estimated heart rate signal 2200 is correct and does match that of the spectrogram illustrated in FIG. 22C. Namely, the advanced interference filter 2130 is able to remove enough unwanted sunlight interference that the heart rate spectrum may be more easily extracted by spectral algorithms 107 (FIG. 1) designed to pick out the strongest frequency as heart rate. Valencell at [0149]

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	 Valencell at fig 22a, 22b, 22c, 22d. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive	Valencell discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample.

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measurement on blood contained within the sample,	Apparatus and methods for attenuating environmental interference are described. A wearable monitoring apparatus includes a housing configured to be attached to the body of a subject and a sensor module that includes an energy emitter that directs energy at a target region of the subject, a detector that detects an energy response signal—or physiological condition—from the subject, a filter that removes time-varying environmental interference from the energy response signal, and at least one processor that controls operations of the energy emitter, detector, and filter. Valencell at Abstract. According to some embodiments of the present invention, a wearable monitoring apparatus includes a housing (e.g., an earpiece, earbud, etc.), and a sensor module disposed within or attached to the housing. The housing is configured to be attached to a body of a subject, for example the ear. The sensor module includes an energy emitter, a detector, a filter, and at least one processor. The energy emitter directs energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, mechanical energy, magnetic energy, nuclear energy, etc.) at a target region of the subject and the detector detects an energy response signal from the subject. The energy response signal is associated with a physiological condition of the subject (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.). The filter removes or attenuates time-varying environmental interference from the energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Valencell at [0006] According to some embodiments of the present invention, a monitoring apparatus includes a housing configured to be attached to the ear of a subject, and a sensor module disposed within or attached to the housing. The sensor module includes an optical emitter, a detector, a motion/position sensor, a filter, and at least one processor that controls operations of the optical emitter, detector, and/or filter. The optical emitter directs optical energy at a target region of the subject and the detector detects an optical energy response signal from the subject, wherein the energy response signal is associated with a physiological condition of the subject. Light-opaque material surrounds at least part of the sensor module to prevent ambient light from interfering with the detector. Output from the motion/position sensor is associated with the motion or position between the housing and ear of the subject. The filter removes or attenuates time-varying environmental interference from the optical energy response signal, wherein the time-

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	varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, and temperature. Valencell at [0012] According to other embodiments of the present invention, an earbud for a headset includes a housing that is configured to be positioned within an ear of a subject, a speaker, and at least one sensor module disposed within or attached to the housing. The at least one sensor module includes a printed circuit board (PCB) having opposite first and second sides, an optical emitter attached to at least one side of the PCB that directs electromagnetic radiation at a target region of the ear, an optical detector attached to at least one side of the PCB adjacent to the optical emitter that detects an energy response signal associated with a physiological condition of the subject from the subject, and an optical filter overlying at least a portion of the optical detector, wherein the optical filter is configured to attenuate (e.g., reduce or block) light at one or more selected wavelengths. A filter may be included that removes time-varying environmental interference from the energy response signal. Time-varying environmental interference may be caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. The at least one sensor module may include at least one processor that controls operations of the optical emitter, optical detector, and/or filter. Valencell at [0019]. According to other embodiments of the present invention, a method of monitoring at least one physiological property of a subject includes directing pulsed energy at a target region of the subject via an energy emitter, obtaining a first energy response signal from the subject when the emitter is on, obtaining a second energy response signal from the subject when the emitter is off, and processing the first and second energy response signals via an interference filter to produce a processed energy response signal that is associated with a physiological condition (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.) of the subject, wherein the filter removes or attenuates time-varying environmental interference caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Directing pulsed energy at a target region may include directing energy selected from the group consisting of optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc.

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	Valencell at [0033]. In some embodiments of the present invention, the geometrical configuration of an emitter and detector may be oriented to maximize the collection of the energy response signal associated with physiological conditions and to minimize the collection of the unwanted scattered light response. Valencell at [0037]. The sensor module includes an energy emitter, a detector, a filter, and at least one processor. The energy emitter directs energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, mechanical energy, magnetic energy, nuclear energy, etc.) at a target region of the subject and the detector detects an energy response signal from the subject. The energy response signal is associated with a physiological condition of the subject (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.). The filter removes or attenuates time-varying environmental interference from the energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Valencell at [0044] FIG. 1 illustrates an interference filtering apparatus/method 100, according to some embodiments of the present invention. A medium 130, preferably physiological material of a living subject, comprises at least one target region of interest 120 which is interrogated by energy 110, preferably modulated energy, such as pulsed energy, generated by an energy emitter 102. A pulsed driving circuit 101 is used to drive at least one energy emitter 102 at one or more pulsed frequencies to interrogate at least one target region of at least one medium 130 with the pulsed energy 110. The energy may be in the form of electromagnetic, acoustical, mechanical, nuclear, electrical, magnetic, thermal, or other forms of energy, but typically optical energy from the electromagnetic spectrum. The energy reaching the medium 130 can interact with the medium to generate at least one energy response signal 111, such as an optical scatter signal 111 between emitted optical energy 110 and the medium 130. The energy response 111 caused by this interaction is detected by at least one detector 103, configured to detect energy in the forms described above, but typically in the form of optical energy scattered from the medium 130. A motion/position sensor 104 may be configured to measure movement, positional changes, or inertial

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	changes in the vicinity of the medium 130. The outputs of the detector 103 may be sent to at least one analog-to-digital convertor (ADC) 105 and the digitized output may be sent to at least one interference filter 106, which is configured to remove the effects of time-varying environmental interference 140 from the signal output of the detector 103. At least one motion/position sensor 104 may be incorporated in the interference filtering method 100 to provide a reference signal for removing the effects of motion from the extracted energy response signal 111 to produce a desired signal 109. For example, the output of the interference filter 106 may be further processed by signal extraction filter 107 to extract accurate information from the medium 130, and this signal extraction filter 107 may utilize the output of the motion/position sensor 104 to remove motion artifacts from the desired signal (the extracted energy response signal) 109. At least one signal processor (not shown) may be used to control the operations of the energy emitter 102, detector 103, filter 106, and/or other components of the interference filtering method 100. Valencell at [0107] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the

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	subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes

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	in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	Valencell discloses or renders obvious the receiver configured to synchronize to the light source. In some embodiments of the present invention, the energy emitter emits pulsed or modulated energy. Valencell at [0008] In some embodiments of the present invention, the energy emitter emits pulsed or modulated energy. Valencell at [0046] The term "modulated energy", as used herein, refers to energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc.) that is emitted in pulses and/or that is emitted such that the amplitude, frequency, phase, or intensity is varied. A pulsed energy source modulates by effectively multiplying by a waveform that is a periodic sequence of zeros and ones. Valencell at [0097]

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	FIG. 1 illustrates an interference filtering apparatus/method 100, according to some embodiments of the present invention. A medium 130, preferably physiological material of a living subject, comprises at least one target region of interest 120 which is interrogated by energy 110, preferably modulated energy, such as pulsed energy, generated by an energy emitter 102. A pulsed driving circuit 101 is used to drive at least one energy emitter 102 at one or more pulsed frequencies to interrogate at least one target region of at least one medium 130 with the pulsed energy 110. The energy may be in the form of electromagnetic, acoustical, mechanical, nuclear, electrical, magnetic, thermal, or other forms of energy, but typically optical energy from the electromagnetic spectrum. The energy reaching the medium 130 can interact with the medium to generate at least one energy response signal 111, such as an optical scatter signal 111 between emitted optical energy 110 and the medium 130. The energy response 111 caused by this interaction is detected by at least one detector 103, configured to detect energy in the forms described above, but typically in the form of optical energy scattered from the medium 130. A motion/position sensor 104 may be configured to measure movement, positional changes, or inertial changes in the vicinity of the medium 130. The outputs of the detector 103 may be sent to at least one analog-to-digital convertor (ADC) 105 and the digitized output may be sent to at least one interference filter 106, which is configured to remove the effects of time-varying environmental interference 140 from the signal output of the detector 103. At least one motion/position sensor 104 may be incorporated in the interference filtering method 100 to provide a reference signal for removing the effects of motion from the extracted energy response signal 111 to produce a desired signal 109. For example, the output of the interference filter 106 may be further processed by signal extraction filter 107 to extract accurate information from the medium 130, and this signal extraction filter 107 may utilize the output of the motion/position sensor 104 to remove motion artifacts from the desired signal (the extracted energy response signal) 109. At least one signal processor (not shown) may be used to control the operations of the energy emitter 102, detector 103, filter 106, and/or other components of the interference filtering method 100. Valencell at [0107] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters

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	(such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the

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	opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the	Valencell discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal.

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captured light into a first signal,	According to other embodiments of the present invention, a method of monitoring at least one physiological property of a subject includes directing pulsed energy at a target region of the subject via an energy emitter, obtaining a first energy response signal from the subject when the emitter is on, obtaining a second energy response signal from the subject when the emitter is off, and processing the first and second energy response signals via an interference filter to produce a processed energy response signal that is associated with a physiological condition (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.) of the subject, wherein the filter removes or attenuates time-varying environmental interference caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Directing pulsed energy at a target region may include directing energy selected from the group consisting of optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc. Valencell at [0033] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the

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	subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] An exemplary filter processes samples 1910, the off/on samples 1920/1930 respectively, taken from a digitized physiological sensor signal 1911 generated by a detector (e.g., 103, FIG. 1) as shown in FIGS. 19A-19B. A pulsed emitter (e.g., 102, FIG. 1) generates a pulsed beam of light such that some samples 1920 represent signal 1911 from a detector with the emitter turned off and other samples 1930 represent signal 1911 from the detector with the emitter turned on. Both types of samples 1920 and 1930 may contain environmental noise from environmental interferants, but only emitter-on samples 1930 contain physiological information generated by the emitter energy. The digitized samples taken from detector signal 1911, provided by an ADC (e.g., 105, FIG. 1), are processed by an interference filter (e.g., 106, FIG. 1) and the output of the interference filter may be directed for further processing (represented by 107, FIG. 1). Valencell at [0137] These operations are summarized in FIG. 18, which is a flow chart of operations for removing environmental noise from a sensor signal via an interference filter, according to some embodiments of the present invention. At Block 1800, at least one ADC sample is read when the emitter is on. At Block 1802, at least one ADC sample is read when the emitter is off. At Block 1804, relevant on/off samples are input to an interference filter. At Block 1806, at least one sample from the interference filter is output for further processing.

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	Valencell at [0138]. An interference filter (e.g., 106, FIG. 1) utilized according to embodiments of the present invention, may vary in nature and complexity. For example, an interference filter may subtract temporally neighboring emitter-off samples 1920 (FIG. 19A) from temporally neighboring emitter-on samples 1930 (FIG. 19A) and output a "subtraction" signal for further processing. In this embodiment, the subtraction may involve subtracting temporally neighboring on/off samples, averaging temporally neighboring on samples and averaging temporally neighboring off samples and then subtracting the average off samples from the average on samples, or by other approaches to subtracting off signals 1920 from on signals 1930. When choosing a subtraction approach, it is important to consider the emitter pulsing frequency and sampling approach. For example, choosing a frequency that is too low may result in unsatisfactory subtraction, as the dynamic environmental conditions between off-states 1920 and on-states 1930 may be too abrupt for the sampling frequency, such that the physiological state of interest is not properly characterized by the interference filter. Thus, the sampling frequency may need to be much higher than the Nyquist frequency required for characterizing the signal in a stationary environment. As a specific example, if an interference filter (e.g., 106, FIG. 1) is being used to remove sunlight interference (e.g., SL1, SL2, FIG. 3), from a photoplethysmogram 1911 (FIGS. 19A, 19B), and if the desired processed output from the final filtering is heart rate, then the Nyquist criteria for pulsing the emitter may be 2×fmax, where fmax is the maximum heart rate of interest, which is likely to be somewhere around 200 beats/minute (BPM) or 3.33 Hz. Valencell at [0139]. However, a person running through alternating shadows may generate a sunlight interference frequency greater than 10 Hz. In such case, it may be desirable to select a sampling frequency greater than twice the sunlight interference frequency, which in this case would be greater than 20 Hz. Samples that are temporally neighboring (located close to each other in time) may be averaged in this case to help remove noise associated with unintended transients. For example, the off samples 1920 (FIGS. 19A, 19B) that come before, and/or after, a given on sample 1930 (FIGS. 19A, 19B) may be averaged and then that average may be subtracted from the on sample 1930 (or average of the on samples), and this final result may be passed along for further processing. Valencell at [0140].

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	As another example, a batch of data may be defined to consist of: 1) a set number of on/off optical detector samples, for instance 6 interleaved on/off samples, 2) a set number of motion sensor samples, for instance 3 samples (one for each on/off optical sample), and 3) a time delay. The time delay may be adjusted to generate the desired batch rate or batch frequency. The 6 on/off optical samples may be input to a multi-tap filter, for instance an M-tap weighted sum filter, and the output may be defined as 1 output per batch for the interference filter. If the optical on/off samples are extended to fill the whole batch period by "N" samples, then the decimation factor is "N", and the effective sample rate is N*batch rate. The parameters for adjustment in this filter may then be N and M, where M is the number of taps in the filter. The batch rate may be chosen to avoid aliasing of interfering harmonics from the desired physical condition monitored, such as the heart rate. For example, batch rate may be chosen as 10*HRmax, where HRmax is the maximum heart rate to be measured. The batch rate may dominate the MIPS (million instructions per second) used by a signal processor, such as a DSP (digital signal processor), since it affects the spectral transform of the desired output signal. In this filtering embodiment, to minimize aliasing from interfering sunlight-shadow changes on the desired heart rate output signal (especially for running or cycling through shadows), a increasing the N and/or M may be preferred. Valencell at [0141]. Another example of a batch may include nine (9) optical segments per batch: off-on-off-on-off-on-off-on-off. Within a given batch, the average of the "off" samples may be subtracted from the average of the "on" samples, providing one output per batch. This would generate a decimation factor of nine (9). Additional batch configurations and on/off configurations may be used in this invention. Valencell at [0142]. It should be noted that the modulated light 110 may be pulsed completely on or completely off, or it may be pulsed partially on or partially off. In some embodiments, for example, the modulated light may be sinusoidal. A benefit of complete on/off pulsing is that it may better-facilitate the signal processing methodologies outlined herein for attenuating environmental noise and motion-coupled environmental noise from one or more output signals. Valencell at [0143].

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	A finite impulse response (FIR) version of an interference filter, according to some embodiments of the present invention, levering the pulsed-emitter on/off sampling rate, is presented in FIG. 20 and identified as 2000. The illustrated interference filter 2000 employs a delay of "n" samples according to Z−n. Coefficients in the filter "bn" allow multi-tap filtering. Pulsing an emitter (e.g., 102, FIG. 1) and selectively sampling on/off signals, as described herein, may modulate the physiological signal to a higher frequency. Thus, the output y(n) of the interference filter 2000 may be decimated to demodulate the output back into the baseband. A specific example of a decimation-by-2 algorithm may reject odd-numbered samples such that the decimated signal, w(m), may be described by even-numbered samples according to w(m)=y(2*m). Valencell at [0144]. Examples of filters embodying the interference filter 2000, for removing sunlight interference from a PPG signal 1911 (FIGS. 19A, 19B) to extract heart rate, according to embodiments of the present invention, are illustrated in the plot 2100 of FIG. 21. The plot 2100 presents the magnitude response (in dB) for each interference filter vs. normalized frequency (1=Nyquist). Also shown in FIG. 21 is a representation of the modulated heart rate 2160 modulated by the emitter on/off sample rate, the demodulated heart rate 2140 demodulated by decimation, and the interference frequency associated with dynamic sunlight noise 2150. As a specific example for the previously described "subtraction filter" 2110, the FIR coefficients may be [b1 b2]=[1 −1]. A filter 2120 for subtracting the temporally neighboring off-samples 1920, coming before and after a given on-sample 1930, may employ coefficients of [−0.05 1 −0.5]. A filter 2130 using multiple on/off samples may employ coefficients of [−0.07 0.3−0.6 0.6−0.3 0.07]. Valencell at [0145]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Valencell discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal. According to other embodiments of the present invention, a method of monitoring at least one physiological property of a subject includes directing pulsed energy at a target region of the subject via an energy emitter, obtaining a first energy response signal from the subject when the emitter is on, obtaining a second energy response signal from the subject when the emitter is off, and processing the first and second energy response signals via an interference filter to produce a processed energy response signal that is associated with a physiological condition (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.) of the subject, wherein the filter removes or attenuates time-varying environmental interference caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Directing pulsed energy at a target region may include directing energy selected from the group consisting of optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc. Valencell at [0033] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in

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	other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] An exemplary filter processes samples 1910, the off/on samples 1920/1930 respectively, taken from a digitized physiological sensor signal 1911 generated by a detector (e.g., 103, FIG. 1) as shown in FIGS. 19A-19B. A pulsed emitter (e.g., 102, FIG. 1) generates a pulsed beam of light such that some samples 1920 represent signal 1911 from a detector with the emitter turned off and other samples 1930 represent signal 1911 from the detector with the emitter turned on. Both types of samples 1920 and 1930 may contain environmental noise from environmental interferants, but only emitter-on samples 1930 contain physiological information generated by the emitter energy. The digitized samples taken from detector signal 1911, provided by an ADC (e.g., 105, FIG. 1), are processed by an interference filter (e.g., 106, FIG. 1) and the output of the interference filter may be directed for further processing (represented by 107, FIG. 1). Valencell at [0137]

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	At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured Valencell at [0109] These operations are summarized in FIG. 18, which is a flow chart of operations for removing environmental noise from a sensor signal via an interference filter, according to some embodiments of the present invention. At Block 1800, at least one ADC sample is read when the emitter is on. At Block 1802, at least one ADC sample is read when the emitter is off. At Block 1804, relevant on/off samples are input to an interference filter. At Block 1806, at least one sample from the interference filter is output for further processing. Valencell at [0138] An interference filter (e.g., 106, FIG. 1) utilized according to embodiments of the present invention, may vary in nature and complexity. For example, an interference filter may subtract temporally neighboring emitter-off samples 1920 (FIG. 19A) from temporally neighboring emitter-on samples 1930 (FIG. 19A) and output a "subtraction" signal for further processing. In this embodiment, the subtraction may involve subtracting temporally neighboring on/off samples, averaging temporally neighboring on samples and averaging temporally neighboring off samples and then subtracting the average off samples from the average on samples, or by other approaches to subtracting off signals 1920 from on signals 1930. When choosing a subtraction approach, it is important to consider the emitter pulsing frequency and sampling approach. For example, choosing a frequency that is too low may result in unsatisfactory subtraction, as the dynamic environmental conditions between off-states 1920 and on-states 1930 may be too abrupt for the sampling frequency, such that the physiological state of interest is not properly characterized by the interference filter. Thus, the sampling frequency may need to be much higher than the Nyquist frequency required for characterizing the signal in a stationary environment. As a specific example, if an interference filter (e.g., 106, FIG. 1) is being used to remove sunlight interference (e.g., SL1, SL2, FIG. 3), from a photoplethysmogram 1911 (FIGS. 19A, 19B), and if the desired processed output from the final filtering is heart rate, then the Nyquist criteria for pulsing the emitter may be 2×fmax, where fmax is the maximum heart rate of interest, which is likely to be somewhere around 200 beats/minute (BPM) or 3.33 Hz.

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	Valencell at [0139]. However, a person running through alternating shadows may generate a sunlight interference frequency greater than 10 Hz. In such case, it may be desirable to select a sampling frequency greater than twice the sunlight interference frequency, which in this case would be greater than 20 Hz. Samples that are temporally neighboring (located close to each other in time) may be averaged in this case to help remove noise associated with unintended transients. For example, the off samples 1920 (FIGS. 19A, 19B) that come before, and/or after, a given on sample 1930 (FIGS. 19A, 19B) may be averaged and then that average may be subtracted from the on sample 1930 (or average of the on samples), and this final result may be passed along for further processing. Valencell at [0140]. As another example, a batch of data may be defined to consist of: 1) a set number of on/off optical detector samples, for instance 6 interleaved on/off samples, 2) a set number of motion sensor samples, for instance 3 samples (one for each on/off optical sample), and 3) a time delay. The time delay may be adjusted to generate the desired batch rate or batch frequency. The 6 on/off optical samples may be input to a multi-tap filter, for instance an M-tap weighted sum filter, and the output may be defined as 1 output per batch for the interference filter. If the optical on/off samples are extended to fill the whole batch period by "N" samples, then the decimation factor is "N", and the effective sample rate is N*batch rate. The parameters for adjustment in this filter may then be N and M, where M is the number of taps in the filter. The batch rate may be chosen to avoid aliasing of interfering harmonics from the desired physical condition monitored, such as the heart rate. For example, batch rate may be chosen as 10*HRmax, where HRmax is the maximum heart rate to be measured. The batch rate may dominate the MIPS (million instructions per second) used by a signal processor, such as a DSP (digital signal processor), since it affects the spectral transform of the desired output signal. In this filtering embodiment, to minimize aliasing from interfering sunlight-shadow changes on the desired heart rate output signal (especially for running or cycling through shadows), a increasing the N and/or M may be preferred. Valencell at [0141]. Another example of a batch may include nine (9) optical segments per batch: off-on-off-on-off-on-off-on-off. Within a given batch, the average of the "off" samples may be subtracted from the average of the

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	"on" samples, providing one output per batch. This would generate a decimation factor of nine (9). Additional batch configurations and on/off configurations may be used in this invention. Valencell at [0142]. It should be noted that the modulated light 110 may be pulsed completely on or completely off, or it may be pulsed partially on or partially off. In some embodiments, for example, the modulated light may be sinusoidal. A benefit of complete on/off pulsing is that it may better-facilitate the signal processing methodologies outlined herein for attenuating environmental noise and motion-coupled environmental noise from one or more output signals. Valencell at [0143]. A finite impulse response (FIR) version of an interference filter, according to some embodiments of the present invention, levering the pulsed-emitter on/off sampling rate, is presented in FIG. 20 and identified as 2000. The illustrated interference filter 2000 employs a delay of "n" samples according to Z−n. Coefficients in the filter "bn" allow multi-tap filtering. Pulsing an emitter (e.g., 102, FIG. 1) and selectively sampling on/off signals, as described herein, may modulate the physiological signal to a higher frequency. Thus, the output y(n) of the interference filter 2000 may be decimated to demodulate the output back into the baseband. A specific example of a decimation-by-2 algorithm may reject odd-numbered samples such that the decimated signal, w(m), may be described by even-numbered samples according to w(m)=y(2*m). Valencell at [0144]. Examples of filters embodying the interference filter 2000, for removing sunlight interference from a PPG signal 1911 (FIGS. 19A, 19B) to extract heart rate, according to embodiments of the present invention, are illustrated in the plot 2100 of FIG. 21. The plot 2100 presents the magnitude response (in dB) for each interference filter vs. normalized frequency (1=Nyquist). Also shown in FIG. 21 is a representation of the modulated heart rate 2160 modulated by the emitter on/off sample rate, the demodulated heart rate 2140 demodulated by decimation, and the interference frequency associated with dynamic sunlight noise 2150. As a specific example for the previously described "subtraction filter" 2110, the FIR coefficients may be [b1 b2]=[1 −1]. A filter 2120 for subtracting the temporally neighboring off-samples 1920, coming before and after a given on-sample 1930, may employ

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	coefficients of [−0.05 1 −0.5]. A filter 2130 using multiple on/off samples may employ coefficients of [−0.07 0.3−0.6 0.6−0.3 0.07]. Valencell at [0145]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Valencell discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal . According to other embodiments of the present invention, a method of monitoring at least one physiological property of a subject includes directing pulsed energy at a target region of the subject via an energy emitter, obtaining a first energy response signal from the subject when the emitter is on, obtaining a second energy response signal from the subject when the emitter is off, and processing the first and second energy response signals via an interference filter to produce a processed energy response signal that is associated with a physiological condition (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.) of the subject, wherein the filter removes or attenuates time-varying environmental interference caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Directing pulsed energy at a target region may include directing energy selected from the group consisting of optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc. Valencell at [0033] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter,

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	is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may

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	provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, collecting light at different wavelengths, and processing these signals collectively, can be used to generate assessments of blood gas levels, such as blood oxygen (SpO2) and carbon dioxide (SpCO2), blood hemoglobin types and levels, or other blood constituents and their respective concentration levels. Multiple wavelengths may be generated by a signal multiwavelength optical emitter, multiple optical emitters, optically filtered optical emitters, or the like. In such case, multiple optical emitters 102 may be located between the two optical filters 715. Valencell at [0130] An exemplary filter processes samples 1910, the off/on samples 1920/1930 respectively, taken from a digitized physiological sensor signal 1911 generated by a detector (e.g., 103, FIG. 1) as shown in FIGS. 19A-19B. A pulsed emitter (e.g., 102, FIG. 1) generates a pulsed beam of light such that some samples 1920 represent signal 1911 from a detector with the emitter turned off and other samples 1930 represent signal 1911 from the detector with the emitter turned on. Both types of samples 1920 and 1930 may contain environmental noise from environmental interferants, but only emitter-on samples 1930 contain physiological information generated by the emitter energy. The digitized samples taken from detector signal 1911, provided by an ADC (e.g., 105, FIG. 1), are processed by an interference filter (e.g., 106, FIG. 1) and the output of the interference filter may be directed for further processing (represented by 107, FIG. 1). Valencell at [0137] These operations are summarized in FIG. 18, which is a flow chart of operations for removing environmental noise from a sensor signal via an interference filter, according to some embodiments of the present invention. At Block 1800, at least one ADC sample is read when the emitter is on. At Block

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	1802, at least one ADC sample is read when the emitter is off. At Block 1804, relevant on/off samples are input to an interference filter. At Block 1806, at least one sample from the interference filter is output for further processing. Valencell at [0138] An interference filter (e.g., 106, FIG. 1) utilized according to embodiments of the present invention, may vary in nature and complexity. For example, an interference filter may subtract temporally neighboring emitter-off samples 1920 (FIG. 19A) from temporally neighboring emitter-on samples 1930 (FIG. 19A) and output a "subtraction" signal for further processing. In this embodiment, the subtraction may involve subtracting temporally neighboring on/off samples, averaging temporally neighboring on samples and averaging temporally neighboring off samples and then subtracting the average off samples from the average on samples, or by other approaches to subtracting off signals 1920 from on signals 1930. When choosing a subtraction approach, it is important to consider the emitter pulsing frequency and sampling approach. For example, choosing a frequency that is too low may result in unsatisfactory subtraction, as the dynamic environmental conditions between off-states 1920 and on-states 1930 may be too abrupt for the sampling frequency, such that the physiological state of interest is not properly characterized by the interference filter. Thus, the sampling frequency may need to be much higher than the Nyquist frequency required for characterizing the signal in a stationary environment. As a specific example, if an interference filter (e.g., 106, FIG. 1) is being used to remove sunlight interference (e.g., SL1, SL2, FIG. 3), from a photoplethysmogram 1911 (FIGS. 19A, 19B), and if the desired processed output from the final filtering is heart rate, then the Nyquist criteria for pulsing the emitter may be 2×fmax, where fmax is the maximum heart rate of interest, which is likely to be somewhere around 200 beats/minute (BPM) or 3.33 Hz. Valencell at [0139] However, a person running through alternating shadows may generate a sunlight interference frequency greater than 10 Hz. In such case, it may be desirable to select a sampling frequency greater than twice the sunlight interference frequency, which in this case would be greater than 20 Hz. Samples that are temporally neighboring (located close to each other in time) may be averaged in this case to help remove noise associated with unintended transients. For example, the off samples 1920 (FIGS. 19A, 19B) that come before, and/or after, a given on sample 1930 (FIGS. 19A, 19B) may be averaged and then that

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	average may be subtracted from the on sample 1930 (or average of the on samples), and this final result may be passed along for further processing. Valencell at [0140]. As another example, a batch of data may be defined to consist of: 1) a set number of on/off optical detector samples, for instance 6 interleaved on/off samples, 2) a set number of motion sensor samples, for instance 3 samples (one for each on/off optical sample), and 3) a time delay. The time delay may be adjusted to generate the desired batch rate or batch frequency. The 6 on/off optical samples may be input to a multi-tap filter, for instance an M-tap weighted sum filter, and the output may be defined as 1 output per batch for the interference filter. If the optical on/off samples are extended to fill the whole batch period by "N" samples, then the decimation factor is "N", and the effective sample rate is N*batch rate. The parameters for adjustment in this filter may then be N and M, where M is the number of taps in the filter. The batch rate may be chosen to avoid aliasing of interfering harmonics from the desired physical condition monitored, such as the heart rate. For example, batch rate may be chosen as 10*HRmax, where HRmax is the maximum heart rate to be measured. The batch rate may dominate the MIPS (million instructions per second) used by a signal processor, such as a DSP (digital signal processor), since it affects the spectral transform of the desired output signal. In this filtering embodiment, to minimize aliasing from interfering sunlight-shadow changes on the desired heart rate output signal (especially for running or cycling through shadows), a increasing the N and/or M may be preferred. Valencell at [0141]. Another example of a batch may include nine (9) optical segments per batch: off-on-off-on-off-on-off-on-off. Within a given batch, the average of the "off" samples may be subtracted from the average of the "on" samples, providing one output per batch. This would generate a decimation factor of nine (9). Additional batch configurations and on/off configurations may be used in this invention. Valencell at [0142]. It should be noted that the modulated light 110 may be pulsed completely on or completely off, or it may be pulsed partially on or partially off. In some embodiments, for example, the modulated light may be sinusoidal. A benefit of complete on/off pulsing is that it may better-facilitate the signal processing

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	methodologies outlined herein for attenuating environmental noise and motion-coupled environmental noise from one or more output signals. Valencell at [0143]. A finite impulse response (FIR) version of an interference filter, according to some embodiments of the present invention, levering the pulsed-emitter on/off sampling rate, is presented in FIG. 20 and identified as 2000. The illustrated interference filter 2000 employs a delay of “n” samples according to Z−n. Coefficients in the filter “bn” allow multi-tap filtering. Pulsing an emitter (e.g., 102, FIG. 1) and selectively sampling on/off signals, as described herein, may modulate the physiological signal to a higher frequency. Thus, the output y(n) of the interference filter 2000 may be decimated to demodulate the output back into the baseband. A specific example of a decimation-by-2 algorithm may reject odd-numbered samples such that the decimated signal, w(m), may be described by even-numbered samples according to w(m)=y(2*m). Valencell at [0144]. Examples of filters embodying the interference filter 2000, for removing sunlight interference from a PPG signal 1911 (FIGS. 19A, 19B) to extract heart rate, according to embodiments of the present invention, are illustrated in the plot 2100 of FIG. 21. The plot 2100 presents the magnitude response (in dB) for each interference filter vs. normalized frequency (1=Nyquist). Also shown in FIG. 21 is a representation of the modulated heart rate 2160 modulated by the emitter on/off sample rate, the demodulated heart rate 2140 demodulated by decimation, and the interference frequency associated with dynamic sunlight noise 2150. As a specific example for the previously described “subtraction filter” 2110, the FIR coefficients may be [b1 b2]=[1 −1]. A filter 2120 for subtracting the temporally neighboring off-samples 1920, coming before and after a given on-sample 1930, may employ coefficients of [−0.05 1 −0.5]. A filter 2130 using multiple on/off samples may employ coefficients of [−0.07 0.3−0.6 0.6−0.3 0.07]. Valencell at [0145]. It should be noted from FIG. 21 that interference filter 2000 may reject more unwanted sunlight than less complex filters. Because the dominant sunlight noise frequencies 2150 may be located at lower

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	frequencies, and because the modulated heart rate signal frequency 2160 may be located at a much higher frequency, most or all of the sunlight noise 2150 may be rejected by the interference filter 2130. Then through demodulation in further-processing (e.g., 107, FIG. 1), the heart rate signal may be returned to the baseband so that real-time heart rate may be extracted. Valencell at [0146] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	Valencell discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. The method of claim 26, further comprising transmitting the processed energy response signal to a remote device. Valencell at Claim 30. In some embodiments of the present invention, the processed energy response signal is transmitted to a remote device, for example wirelessly transmitted. Valencell at [0035] Embodiments of the present invention are not limited to headsets that communicate wirelessly. In some embodiments of the present invention, headsets configured to monitor an individual's physiology and/or environment may be wired to a device that stores and/or processes data or there may be a combination

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	of wired and wireless communications. In some embodiments, this information may be stored on the headset itself. Furthermore, embodiments of the present invention are not limited to earbuds. In some embodiments, the invention may be employed around another part of the body, such as a digit, finger, toe, limb, wrist, ankle, around the nose or earlobe, or the like. In other embodiments, the invention may be integrated into a patch, such as a bandage that sticks on a person's body. Valencell at [0106] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Valencell discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. The method of claim 26, further comprising transmitting the processed energy response signal to a remote device. Valencell at Claim 30. In some embodiments of the present invention, the processed energy response signal is transmitted to a remote device, for example wirelessly transmitted. Valencell at [0035] Embodiments of the present invention are not limited to headsets that communicate wirelessly. In some embodiments of the present invention, headsets configured to monitor an individual's physiology and/or environment may be wired to a device that stores and/or processes data or there may be a combination of wired and wireless communications. In some embodiments, this information may be stored on the

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	headset itself. Furthermore, embodiments of the present invention are not limited to earbuds. In some embodiments, the invention may be employed around another part of the body, such as a digit, finger, toe, limb, wrist, ankle, around the nose or earlobe, or the like. In other embodiments, the invention may be integrated into a patch, such as a bandage that sticks on a person's body. Valencell at [0106] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Valencell discloses or renders obvious wherein the measurement system is configured to use artificial intelligence in making decisions. The sensor module includes an energy emitter, a detector, a filter, and at least one processor. The energy emitter directs energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, mechanical energy, magnetic energy, nuclear energy, etc.) at a target region of the subject and the detector detects an energy response signal from the subject. The energy response signal is associated with a physiological condition of the subject (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.). The filter removes or attenuates time-varying environmental interference from the energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Valencell at [0044]

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	Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109] FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the

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	like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, collecting light at different wavelengths, and processing these signals collectively, can be used to generate assessments of blood gas levels, such as blood oxygen (SpO2) and carbon dioxide (SpCO2), blood hemoglobin types and levels, or other blood constituents and their respective concentration levels. Multiple wavelengths may be generated by a signal multiwavelength optical emitter, multiple optical emitters, optically filtered optical emitters, or the like. In such case, multiple optical emitters 102 may be located between the two optical filters 715. Valencell at [0130] A finite impulse response (FIR) version of an interference filter, according to some embodiments of the present invention, levering the pulsed-emitter on/off sampling rate, is presented in FIG. 20 and identified as 2000. The illustrated interference filter 2000 employs a delay of "n" samples according to Z−n. Coefficients in the filter "bn" allow multi-tap filtering. Pulsing an emitter (e.g., 102, FIG. 1) and selectively sampling on/off signals, as described herein, may modulate the physiological signal to a higher frequency. Thus, the output y(n) of the interference filter 2000 may be decimated to demodulate the output back into the baseband. A specific example of a decimation-by-2 algorithm may reject odd-numbered samples such that the decimated signal, w(m), may be described by even-numbered samples according to w(m)=y(2*m). Valencell at [0144] It should be noted that a motion/position sensor (e.g., 104, FIG. 1) utilized in accordance with some embodiments of the present invention may come from a broad range of sensors: inertial sensor, accelerometer, pedometer, gyroscope, microelectromechanical sensor, capacitive sensor, electrical sensor, inductive sensor, optical motion sensor, or the like. This is because many types of sensors may be either intentionally or unintentionally sensitive to motion and/or position. However, in some embodiments of the present invention, a sensor 104 (FIG. 1) and/or processing algorithm are utilized that can identify motion signals from physiological, environmental, or other signals not directly associated

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	with motion. In some embodiments of the present invention, at least one optical detector (e.g., 103, FIG. 1) may also serve as a motion sensor. Motion-related changes in scattered light (e.g., 111, FIG. 1) may be several times greater than blood-flow related changes in scattered light. Thus, the output of at least one detector 103 may be processed with a digital filter, such as a spectral filter, adaptive filter, threshold filter, or the like, to identify only motion-related signals and remove these signals from the desired response (e.g., 109, FIG. 1). Such processing may identify motion-related signals from physiological-related signals. In some embodiments of the present invention, by employing multiple optical detectors (e.g., 102, FIG. 1), motion-related signals may be identified from physiological-related signals by processing signals from the multiple detectors using an algorithm, such as a spectral algorithm. An example of a spectral processing algorithm for identifying motion-related signals, according to some embodiments of the present invention, is to generate a spectral representation of all signals in all detectors (e.g., 102, FIG. 1), identify key frequencies in each signal, and subtract, reduce, or remove all frequencies in common with each detector output. This type of filtering technique may work well because physiological signals may generate similar spectral peaks for all detectors (e.g., 102, FIG. 1) but motion signals may generate dissimilar spectral peaks in at least one detector (e.g., 103, FIG. 1). Another example of processing the detectors (e.g., 102, FIG. 1) to identify and remove motion-related signals is to position at least one detector in a location that does not “see” optical scatter (e.g., 111, FIG. 1) from the body/ear region but instead sees optical scatter from the earbud housing (e.g., 901, FIGS. 9A, 9B) or other material that may move in synchronization with the body. For example, the secondary sensor 730 (FIG. 7) may be an optical detector that measures light scattered from the earbud itself; because the sensor 730 may be facing the earbud and not the ear, only light scatter from the earbud may be detected. Valencell at [0148] FIGS. 22A-22D are graphs of a processed heart rate signal output 109 of an earbud module (e.g., earbud module 207, 700, FIGS. 2, 7) employing two different filter configurations, according to some embodiments of the present invention. The graphs illustrated in FIGS. 22A-22D were generated from data collected from a user wearing an earbud (e.g., 404, FIGS. 4A, 4B) during an outdoor run. FIGS. 22A and 22C show relative spectrograms of frequency vs. time, where the strongest spectral signals show the brightest relative intensities. FIGS. 22B and 22D show the estimates of step rate 2210 and heart rate 2220 following further processing 107 to extract the desired frequencies of interest. FIG. 22A shows the spectrogram of the digitized sensor output from an optical detector (e.g., 103, FIG. 1) following the ADC process (e.g., 105, FIG. 1) without employing an interference filter (e.g., 106, FIG. 1). FIG. 22C shows the spectrogram of the same digitized sensor output of FIG. 22A following signal processing via the

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	interference filter 2130 of FIG. 21. FIG. 22A shows a great deal of broadband noise from sunlight, the strongest signal appears to be the step rate signal 2210, and the heart rate spectrum 2220 appears very faint with respect to the step rate signal. In contrast, FIG. 22C shows substantially less broadband noise from sunlight, the strongest signal appears to be the heart rate signal 2220, and the step rate signal 2210 appears very faint with respect to the heart rate signal. Through further filtering (e.g., 107, FIG. 1), the heart rate 2220 and step rate 2210 may be extracted, as shown in FIGS. 22B and 22D. FIG. 22B shows that the estimated heart rate signal 2200 is incorrect and does not match that of the spectrogram illustrated in FIG. 22A. In contrast, FIG. 22D shows that the estimated heart rate signal 2200 is correct and does match that of the spectrogram illustrated in FIG. 22C. Namely, the advanced interference filter 2130 is able to remove enough unwanted sunlight interference that the heart rate spectrum may be more easily extracted by spectral algorithms 107 (FIG. 1) designed to pick out the strongest frequency as heart rate. Valencell at [0149] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a]. wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Valencell discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. FIG. 1 illustrates an interference filtering apparatus/method 100, according to some embodiments of the present invention. A medium 130, preferably physiological material of a living subject, comprises at least one target region of interest 120 which is interrogated by energy 110, preferably modulated energy, such as pulsed energy, generated by an energy emitter 102. A pulsed driving circuit 101 is used to drive at least one energy emitter 102 at one or more pulsed frequencies to interrogate at least one target region of at least one medium 130 with the pulsed energy 110. The energy may be in the form of electromagnetic, acoustical, mechanical, nuclear, electrical, magnetic, thermal, or other forms of energy, but typically optical energy from the electromagnetic spectrum. The energy reaching the medium 130

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	can interact with the medium to generate at least one energy response signal 111, such as an optical scatter signal 111 between emitted optical energy 110 and the medium 130. The energy response 111 caused by this interaction is detected by at least one detector 103, configured to detect energy in the forms described above, but typically in the form of optical energy scattered from the medium 130. A motion/position sensor 104 may be configured to measure movement, positional changes, or inertial changes in the vicinity of the medium 130. The outputs of the detector 103 may be sent to at least one analog-to-digital convertor (ADC) 105 and the digitized output may be sent to at least one interference filter 106, which is configured to remove the effects of time-varying environmental interference 140 from the signal output of the detector 103. At least one motion/position sensor 104 may be incorporated in the interference filtering method 100 to provide a reference signal for removing the effects of motion from the extracted energy response signal 111 to produce a desired signal 109. For example, the output of the interference filter 106 may be further processed by signal extraction filter 107 to extract accurate information from the medium 130, and this signal extraction filter 107 may utilize the output of the motion/position sensor 104 to remove motion artifacts from the desired signal (the extracted energy response signal) 109. At least one signal processor (not shown) may be used to control the operations of the energy emitter 102, detector 103, filter 106, and/or other components of the interference filtering method 100. Valencell at [0107] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a

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	second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] A finite impulse response (FIR) version of an interference filter, according to some embodiments of the present invention, levering the pulsed-emitter on/off sampling rate, is presented in FIG. 20 and identified as 2000. The illustrated interference filter 2000 employs a delay of "n" samples according to Z−n. Coefficients in the filter "bn" allow multi-tap filtering. Pulsing an emitter (e.g., 102, FIG. 1) and selectively sampling on/off signals, as described herein, may modulate the physiological signal to a higher frequency. Thus, the output y(n) of the interference filter 2000 may be decimated to demodulate the output back into the baseband. A specific example of a decimation-by-2 algorithm may reject odd-numbered samples such that the decimated signal, w(m), may be described by even-numbered samples according to w(m)=y(2*m). Valencell at [0144] It should be noted that a motion/position sensor (e.g., 104, FIG. 1) utilized in accordance with some embodiments of the present invention may come from a broad range of sensors: inertial sensor,

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	accelerometer, pedometer, gyroscope, microelectromechanical sensor, capacitive sensor, electrical sensor, inductive sensor, optical motion sensor, or the like. This is because many types of sensors may be either intentionally or unintentionally sensitive to motion and/or position. However, in some embodiments of the present invention, a sensor 104 (FIG. 1) and/or processing algorithm are utilized that can identify motion signals from physiological, environmental, or other signals not directly associated with motion. In some embodiments of the present invention, at least one optical detector (e.g., 103, FIG. 1) may also serve as a motion sensor. Motion-related changes in scattered light (e.g., 111, FIG. 1) may be several times greater than blood-flow related changes in scattered light. Thus, the output of at least one detector 103 may be processed with a digital filter, such as a spectral filter, adaptive filter, threshold filter, or the like, to identify only motion-related signals and remove these signals from the desired response (e.g., 109, FIG. 1). Such processing may identify motion-related signals from physiological-related signals. In some embodiments of the present invention, by employing multiple optical detectors (e.g., 102, FIG. 1), motion-related signals may be identified from physiological-related signals by processing signals from the multiple detectors using an algorithm, such as a spectral algorithm. An example of a spectral processing algorithm for identifying motion-related signals, according to some embodiments of the present invention, is to generate a spectral representation of all signals in all detectors (e.g., 102, FIG. 1), identify key frequencies in each signal, and subtract, reduce, or remove all frequencies in common with each detector output. This type of filtering technique may work well because physiological signals may generate similar spectral peaks for all detectors (e.g., 102, FIG. 1) but motion signals may generate dissimilar spectral peaks in at least one detector (e.g., 103, FIG. 1). Another example of processing the detectors (e.g., 102, FIG. 1) to identify and remove motion-related signals is to position at least one detector in a location that does not "see" optical scatter (e.g., 111, FIG. 1) from the body/ear region but instead sees optical scatter from the earbud housing (e.g., 901, FIGS. 9A, 9B) or other material that may move in synchronization with the body. For example, the secondary sensor 730 (FIG. 7) may be an optical detector that measures light scattered from the earbud itself; because the sensor 730 may be facing the earbud and not the ear, only light scatter from the earbud may be detected. Valencell at [0148]. FIGS. 22A-22D are graphs of a processed heart rate signal output 109 of an earbud module (e.g., earbud module 207, 700, FIGS. 2, 7) employing two different filter configurations, according to some embodiments of the present invention. The graphs illustrated in FIGS. 22A-22D were generated from data collected from a user wearing an earbud (e.g., 404, FIGS. 4A, 4B) during an outdoor run. FIGS. 22A and 22C show relative spectrograms of frequency vs. time, where the strongest spectral signals show

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	the brightest relative intensities. FIGS. 22B and 22D show the estimates of step rate 2210 and heart rate 2220 following further processing 107 to extract the desired frequencies of interest. FIG. 22A shows the spectrogram of the digitized sensor output from an optical detector (e.g., 103, FIG. 1) following the ADC process (e.g., 105, FIG. 1) without employing an interference filter (e.g., 106, FIG. 1). FIG. 22C shows the spectrogram of the same digitized sensor output of FIG. 22A following signal processing via the interference filter 2130 of FIG. 21. FIG. 22A shows a great deal of broadband noise from sunlight, the strongest signal appears to be the step rate signal 2210, and the heart rate spectrum 2220 appears very faint with respect to the step rate signal. In contrast, FIG. 22C shows substantially less broadband noise from sunlight, the strongest signal appears to be the heart rate signal 2220, and the step rate signal 2210 appears very faint with respect to the heart rate signal. Through further filtering (e.g., 107, FIG. 1), the heart rate 2220 and step rate 2210 may be extracted, as shown in FIGS. 22B and 22D. FIG. 22B shows that the estimated heart rate signal 2200 is incorrect and does not match that of the spectrogram illustrated in FIG. 22A. In contrast, FIG. 22D shows that the estimated heart rate signal 2200 is correct and does match that of the spectrogram illustrated in FIG. 22C. Namely, the advanced interference filter 2130 is able to remove enough unwanted sunlight interference that the heart rate spectrum may be more easily extracted by spectral algorithms 107 (FIG. 1) designed to pick out the strongest frequency as heart rate. Valencell at [0149] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a	Valencell discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed

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signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical

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	emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, collecting light at different wavelengths, and processing these signals collectively, can be used to generate assessments of blood gas levels, such as blood oxygen (SpO2) and carbon dioxide (SpCO2), blood hemoglobin types and levels, or other blood constituents and their respective concentration levels. Multiple wavelengths may be generated by a signal multiwavelength optical emitter, multiple optical emitters, optically filtered optical emitters, or the like. In such case, multiple optical emitters 102 may be located between the two optical filters 715. Valencell at [0130] An exemplary filter processes samples 1910, the off/on samples 1920/1930 respectively, taken from a digitized physiological sensor signal 1911 generated by a detector (e.g., 103, FIG. 1) as shown in FIGS. 19A-19B. A pulsed emitter (e.g., 102, FIG. 1) generates a pulsed beam of light such that some samples 1920 represent signal 1911 from a detector with the emitter turned off and other samples 1930 represent signal 1911 from the detector with the emitter turned on. Both types of samples 1920 and 1930 may contain environmental noise from environmental interferants, but only emitter-on samples 1930 contain physiological information generated by the emitter energy. The digitized samples taken from detector signal 1911, provided by an ADC (e.g., 105, FIG. 1), are processed by an interference filter (e.g., 106, FIG. 1) and the output of the interference filter may be directed for further processing (represented by 107, FIG. 1). Valencell at [0137] These operations are summarized in FIG. 18, which is a flow chart of operations for removing environmental noise from a sensor signal via an interference filter, according to some embodiments of

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	the present invention. At Block 1800, at least one ADC sample is read when the emitter is on. At Block 1802, at least one ADC sample is read when the emitter is off. At Block 1804, relevant on/off samples are input to an interference filter. At Block 1806, at least one sample from the interference filter is output for further processing. Valencell at [0138] An interference filter (e.g., 106, FIG. 1) utilized according to embodiments of the present invention, may vary in nature and complexity. For example, an interference filter may subtract temporally neighboring emitter-off samples 1920 (FIG. 19A) from temporally neighboring emitter-on samples 1930 (FIG. 19A) and output a "subtraction" signal for further processing. In this embodiment, the subtraction may involve subtracting temporally neighboring on/off samples, averaging temporally neighboring on samples and averaging temporally neighboring off samples and then subtracting the average off samples from the average on samples, or by other approaches to subtracting off signals 1920 from on signals 1930. When choosing a subtraction approach, it is important to consider the emitter pulsing frequency and sampling approach. For example, choosing a frequency that is too low may result in unsatisfactory subtraction, as the dynamic environmental conditions between off-states 1920 and on-states 1930 may be too abrupt for the sampling frequency, such that the physiological state of interest is not properly characterized by the interference filter. Thus, the sampling frequency may need to be much higher than the Nyquist frequency required for characterizing the signal in a stationary environment. As a specific example, if an interference filter (e.g., 106, FIG. 1) is being used to remove sunlight interference (e.g., SL1, SL2, FIG. 3), from a photoplethysmogram 1911 (FIGS. 19A, 19B), and if the desired processed output from the final filtering is heart rate, then the Nyquist criteria for pulsing the emitter may be 2×fmax, where fmax is the maximum heart rate of interest, which is likely to be somewhere around 200 beats/minute (BPM) or 3.33 Hz. Valencell at [0139] However, a person running through alternating shadows may generate a sunlight interference frequency greater than 10 Hz. In such case, it may be desirable to select a sampling frequency greater than twice the sunlight interference frequency, which in this case would be greater than 20 Hz. Samples that are temporally neighboring (located close to each other in time) may be averaged in this case to help remove noise associated with unintended transients. For example, the off samples 1920 (FIGS. 19A, 19B) that come before, and/or after, a given on sample 1930 (FIGS. 19A, 19B) may be averaged and then that

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	average may be subtracted from the on sample 1930 (or average of the on samples), and this final result may be passed along for further processing. Valencell at [0140] It should be noted from FIG. 21 that interference filter 2000 may reject more unwanted sunlight than less complex filters. Because the dominant sunlight noise frequencies 2150 may be located at lower frequencies, and because the modulated heart rate signal frequency 2160 may be located at a much higher frequency, most or all of the sunlight noise 2150 may be rejected by the interference filter 2130. Then through demodulation in further-processing (e.g., 107, FIG. 1), the heart rate signal may be returned to the baseband so that real-time heart rate may be extracted. Valencell at [0144]. Examples of filters embodying the interference filter 2000, for removing sunlight interference from a PPG signal 1911 (FIGS. 19A, 19B) to extract heart rate, according to embodiments of the present invention, are illustrated in the plot 2100 of FIG. 21. The plot 2100 presents the magnitude response (in dB) for each interference filter vs. normalized frequency (1=Nyquist). Also shown in FIG. 21 is a representation of the modulated heart rate 2160 modulated by the emitter on/off sample rate, the demodulated heart rate 2140 demodulated by decimation, and the interference frequency associated with dynamic sunlight noise 2150. As a specific example for the previously described "subtraction filter" 2110, the FIR coefficients may be [b1 b2]=[1 −1]. A filter 2120 for subtracting the temporally neighboring off-samples 1920, coming before and after a given on-sample 1930, may employ coefficients of [−0.05 1 −0.5]. A filter 2130 using multiple on/off samples may employ coefficients of [−0.07 0.3−0.6 0.6−0.3 0.07]. Valencell at [0145]. It should be noted from FIG. 21 that interference filter 2000 may reject more unwanted sunlight than less complex filters. Because the dominant sunlight noise frequencies 2150 may be located at lower frequencies, and because the modulated heart rate signal frequency 2160 may be located at a much higher frequency, most or all of the sunlight noise 2150 may be rejected by the interference filter 2130. Then through demodulation in further-processing (e.g., 107, FIG. 1), the heart rate signal may be returned to the baseband so that real-time heart rate may be extracted.

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	Valencell at [0146]. An interference filtering method, according to some embodiments of the present invention, may employ a motion/position sensor (e.g., 104, FIG. 1) to further remove interference from a desired physiological signal (e.g., 109, FIG. 1). For the case of sunlight interference (e.g., 140, FIG. 1) on an earbud sensor module (e.g., 207, FIG. 2), outdoor sunlight may more strongly illuminate an ear and detector 103 in the sensor module 207 than the emitter 102 in the sensor module 207. While an interference filter (e.g., 2130, FIG. 21) may effectively remove the baseband frequencies of this interference, harmonics caused by motion-induced sunlight noise may dominate the digitized signal near the frequencies of the modulated desired information (e.g., 2160, FIG. 21). The step rate of a person running or jogging may be the strongest component of this interference. Moreover, because a person running or jogging may be moving through varying sunlight intensity, the interference signal may be a convolution of motion-coupled-sunlight changes in time. A technique for removing sunlight interference, according to some embodiments of the present invention, utilizes a motion or position sensor (e.g., 104, FIG. 1), such as an inertial sensor, accelerometer, pedometer, gyroscope, microelectromechanical sensor, capacitive sensor, inductive sensor, optical motion sensor, or the like. The step rate may be measured as the peak frequency in the spectrum of the signal coming from motion/position sensor 104 or as the frequency of the spectral peak of the signal coming from the motion/position sensor 104. For example, the processed spectrum may employ differentiation or integration to generate a processed motion/position signal, and the peak frequency of this processed spectrum may be more indicative of the step rate. Harmonics and aliased harmonics of the step rate may determine the frequencies of interference to ignore in the desired-information spectrum. For example, the emitter pulse rate minus eight times the step rate (aliased 8th harmonic) may be the frequency of strong interference in the frequency space of the modulated heart rate (e.g., 2160, FIG. 21), and frequencies within a pre-determined range may be set to zero in the desired-information spectrum. Valencell at [0147]. It should be noted that a motion/position sensor (e.g., 104, FIG. 1) utilized in accordance with some embodiments of the present invention may come from a broad range of sensors: inertial sensor, accelerometer, pedometer, gyroscope, microelectromechanical sensor, capacitive sensor, electrical sensor, inductive sensor, optical motion sensor, or the like. This is because many types of sensors may be either intentionally or unintentionally sensitive to motion and/or position. However, in some

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	embodiments of the present invention, a sensor 104 (FIG. 1) and/or processing algorithm are utilized that can identify motion signals from physiological, environmental, or other signals not directly associated with motion. In some embodiments of the present invention, at least one optical detector (e.g., 103, FIG. 1) may also serve as a motion sensor. Motion-related changes in scattered light (e.g., 111, FIG. 1) may be several times greater than blood-flow related changes in scattered light. Thus, the output of at least one detector 103 may be processed with a digital filter, such as a spectral filter, adaptive filter, threshold filter, or the like, to identify only motion-related signals and remove these signals from the desired response (e.g., 109, FIG. 1). Such processing may identify motion-related signals from physiological-related signals. In some embodiments of the present invention, by employing multiple optical detectors (e.g., 102, FIG. 1), motion-related signals may be identified from physiological-related signals by processing signals from the multiple detectors using an algorithm, such as a spectral algorithm. An example of a spectral processing algorithm for identifying motion-related signals, according to some embodiments of the present invention, is to generate a spectral representation of all signals in all detectors (e.g., 102, FIG. 1), identify key frequencies in each signal, and subtract, reduce, or remove all frequencies in common with each detector output. This type of filtering technique may work well because physiological signals may generate similar spectral peaks for all detectors (e.g., 102, FIG. 1) but motion signals may generate dissimilar spectral peaks in at least one detector (e.g., 103, FIG. 1). Another example of processing the detectors (e.g., 102, FIG. 1) to identify and remove motion-related signals is to position at least one detector in a location that does not "see" optical scatter (e.g., 111, FIG. 1) from the body/ear region but instead sees optical scatter from the earbud housing (e.g., 901, FIGS. 9A, 9B) or other material that may move in synchronization with the body. For example, the secondary sensor 730 (FIG. 7) may be an optical detector that measures light scattered from the earbud itself; because the sensor 730 may be facing the earbud and not the ear, only light scatter from the earbud may be detected. Valencell at [0148] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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	Claim 13
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Valencell discloses or renders obvious wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output

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	may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] An exemplary filter processes samples 1910, the off/on samples 1920/1930 respectively, taken from a digitized physiological sensor signal 1911 generated by a detector (e.g., 103, FIG. 1) as shown in FIGS. 19A-19B. A pulsed emitter (e.g., 102, FIG. 1) generates a pulsed beam of light such that some samples 1920 represent signal 1911 from a detector with the emitter turned off and other samples 1930 represent signal 1911 from the detector with the emitter turned on. Both types of samples 1920 and 1930 may contain environmental noise from environmental interferants, but only emitter-on samples 1930 contain physiological information generated by the emitter energy. The digitized samples taken from detector signal 1911, provided by an ADC (e.g., 105, FIG. 1), are processed by an interference filter (e.g., 106, FIG. 1) and the output of the interference filter may be directed for further processing (represented by 107, FIG. 1). Valencell at [0137] These operations are summarized in FIG. 18, which is a flow chart of operations for removing environmental noise from a sensor signal via an interference filter, according to some embodiments of the present invention. At Block 1800, at least one ADC sample is read when the emitter is on. At Block 1802, at least one ADC sample is read when the emitter is off. At Block 1804, relevant on/off samples are input to an interference filter. At Block 1806, at least one sample from the interference filter is output for further processing. Valencell at [0138] An interference filter (e.g., 106, FIG. 1) utilized according to embodiments of the present invention, may vary in nature and complexity. For example, an interference filter may subtract temporally neighboring emitter-off samples 1920 (FIG. 19A) from temporally neighboring emitter-on samples 1930 (FIG. 19A) and output a “subtraction” signal for further processing. In this embodiment, the subtraction may involve subtracting temporally neighboring on/off samples, averaging temporally neighboring on samples and averaging temporally neighboring off samples and then subtracting the average off samples from the average on samples, or by other approaches to subtracting off signals 1920 from on signals 1930. When

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	choosing a subtraction approach, it is important to consider the emitter pulsing frequency and sampling approach. For example, choosing a frequency that is too low may result in unsatisfactory subtraction, as the dynamic environmental conditions between off-states 1920 and on-states 1930 may be too abrupt for the sampling frequency, such that the physiological state of interest is not properly characterized by the interference filter. Thus, the sampling frequency may need to be much higher than the Nyquist frequency required for characterizing the signal in a stationary environment. As a specific example, if an interference filter (e.g., 106, FIG. 1) is being used to remove sunlight interference (e.g., SL1, SL2, FIG. 3), from a photoplethysmogram 1911 (FIGS. 19A, 19B), and if the desired processed output from the final filtering is heart rate, then the Nyquist criteria for pulsing the emitter may be 2×fmax, where fmax is the maximum heart rate of interest, which is likely to be somewhere around 200 beats/minute (BPM) or 3.33 Hz. Valencell at [0139] However, a person running through alternating shadows may generate a sunlight interference frequency greater than 10 Hz. In such case, it may be desirable to select a sampling frequency greater than twice the sunlight interference frequency, which in this case would be greater than 20 Hz. Samples that are temporally neighboring (located close to each other in time) may be averaged in this case to help remove noise associated with unintended transients. For example, the off samples 1920 (FIGS. 19A, 19B) that come before, and/or after, a given on sample 1930 (FIGS. 19A, 19B) may be averaged and then that average may be subtracted from the on sample 1930 (or average of the on samples), and this final result may be passed along for further processing. Valencell at [0140] It should be noted that the modulated light 110 may be pulsed completely on or completely off, or it may be pulsed partially on or partially off. In some embodiments, for example, the modulated light may be sinusoidal. A benefit of complete on/off pulsing is that it may better-facilitate the signal processing methodologies outlined herein for attenuating environmental noise and motion-coupled environmental noise from one or more output signals. Valencell at [0143]

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	It should be noted from FIG. 21 that interference filter 2000 may reject more unwanted sunlight than less complex filters. Because the dominant sunlight noise frequencies 2150 may be located at lower frequencies, and because the modulated heart rate signal frequency 2160 may be located at a much higher frequency, most or all of the sunlight noise 2150 may be rejected by the interference filter 2130. Then through demodulation in further-processing (e.g., 107, FIG. 1), the heart rate signal may be returned to the baseband so that real-time heart rate may be extracted. Valencell at [0144] Examples of filters embodying the interference filter 2000, for removing sunlight interference from a PPG signal 1911 (FIGS. 19A, 19B) to extract heart rate, according to embodiments of the present invention, are illustrated in the plot 2100 of FIG. 21. The plot 2100 presents the magnitude response (in dB) for each interference filter vs. normalized frequency (1=Nyquist). Also shown in FIG. 21 is a representation of the modulated heart rate 2160 modulated by the emitter on/off sample rate, the demodulated heart rate 2140 demodulated by decimation, and the interference frequency associated with dynamic sunlight noise 2150. As a specific example for the previously described "subtraction filter" 2110, the FIR coefficients may be [b1 b2]=[1 −1]. A filter 2120 for subtracting the temporally neighboring off-samples 1920, coming before and after a given on-sample 1930, may employ coefficients of [−0.05 1 −0.5]. A filter 2130 using multiple on/off samples may employ coefficients of [−0.07 0.3−0.6 0.6−0.3 0.07]. Valencell at [0145]. It should be noted from FIG. 21 that interference filter 2000 may reject more unwanted sunlight than less complex filters. Because the dominant sunlight noise frequencies 2150 may be located at lower frequencies, and because the modulated heart rate signal frequency 2160 may be located at a much higher frequency, most or all of the sunlight noise 2150 may be rejected by the interference filter 2130. Then through demodulation in further-processing (e.g., 107, FIG. 1), the heart rate signal may be returned to the baseband so that real-time heart rate may be extracted. Valencell at [0146]. An interference filtering method, according to some embodiments of the present invention, may employ a motion/position sensor (e.g., 104, FIG. 1) to further remove interference from a desired physiological

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	signal (e.g., 109, FIG. 1). For the case of sunlight interference (e.g., 140, FIG. 1) on an earbud sensor module (e.g., 207, FIG. 2), outdoor sunlight may more strongly illuminate an ear and detector 103 in the sensor module 207 than the emitter 102 in the sensor module 207. While an interference filter (e.g., 2130, FIG. 21) may effectively remove the baseband frequencies of this interference, harmonics caused by motion-induced sunlight noise may dominate the digitized signal near the frequencies of the modulated desired information (e.g., 2160, FIG. 21). The step rate of a person running or jogging may be the strongest component of this interference. Moreover, because a person running or jogging may be moving through varying sunlight intensity, the interference signal may be a convolution of motion-coupled-sunlight changes in time. A technique for removing sunlight interference, according to some embodiments of the present invention, utilizes a motion or position sensor (e.g., 104, FIG. 1), such as an inertial sensor, accelerometer, pedometer, gyroscope, microelectromechanical sensor, capacitive sensor, inductive sensor, optical motion sensor, or the like. The step rate may be measured as the peak frequency in the spectrum of the signal coming from motion/position sensor 104 or as the frequency of the spectral peak of the signal coming from the motion/position sensor 104. For example, the processed spectrum may employ differentiation or integration to generate a processed motion/position signal, and the peak frequency of this processed spectrum may be more indicative of the step rate. Harmonics and aliased harmonics of the step rate may determine the frequencies of interference to ignore in the desired-information spectrum. For example, the emitter pulse rate minus eight times the step rate (aliased 8th harmonic) may be the frequency of strong interference in the frequency space of the modulated heart rate (e.g., 2160, FIG. 21), and frequencies within a pre-determined range may be set to zero in the desired-information spectrum. Valencell at [0147]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	

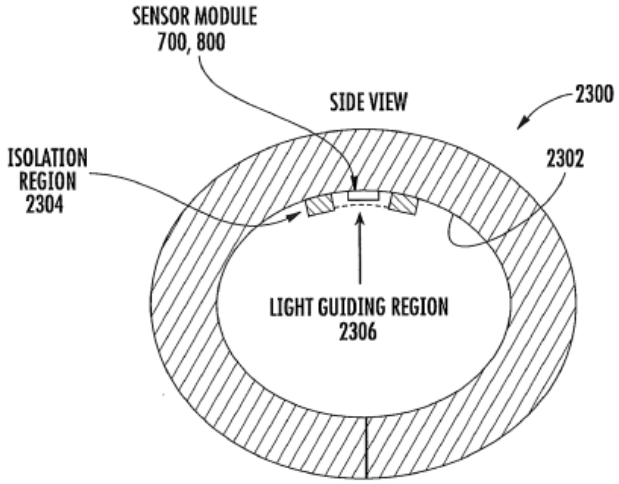
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14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Valencell discloses or renders obvious wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. In some embodiments of the present invention, the energy emitter comprises at least one optical emitter, and the detector comprises at least one optical detector. Exemplary optical emitters include, but are not limited to, LDs, LEDs, and OLEDs. Exemplary optical detectors include, but are not limited to, photodetectors, photodiodes, phototransistors, photoactive resistors, photomultiplier tubes, photomultiplier diodes, photodetector modules, and the like. Vallencell at [0047] In some embodiments of the present invention, the energy emitter comprises at least one optical emitter, and the detector comprises at least one optical detector. Exemplary optical emitters include, but are not limited to, LDs, LEDs, and OLEDs. Exemplary optical detectors include, but are not limited to, photodetectors, photodiodes, phototransistors, photoactive resistors, photomultiplier tubes, photomultiplier diodes, photodetector modules, and the like. Valencell at [0108]. In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region

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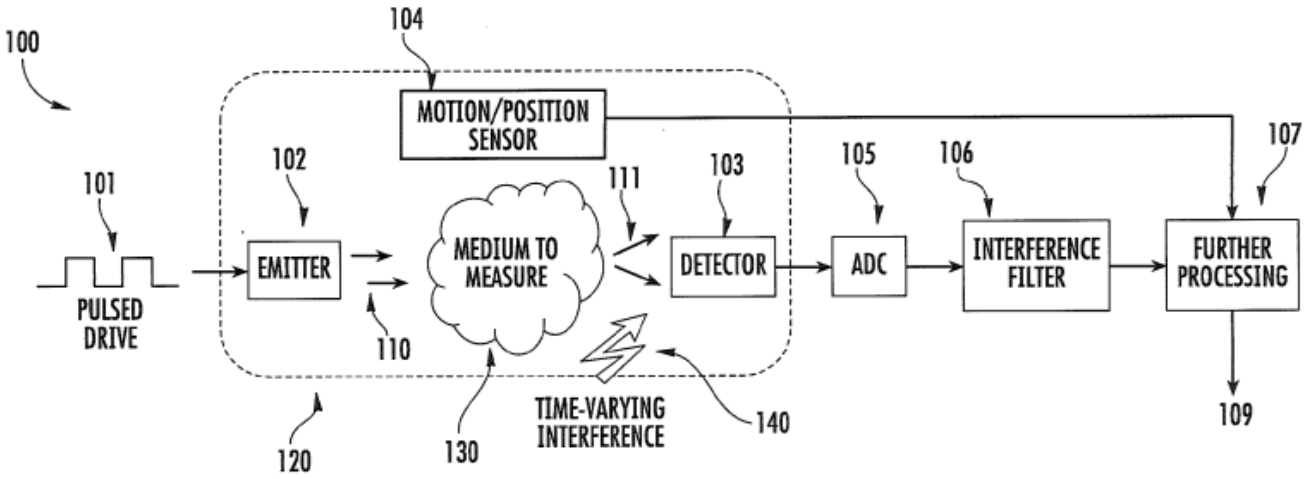
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	130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108]. In some embodiments of the present invention, a light guiding region 2306 may surround or partially surround the sensor module 700, 800 and/or isolation region 2304, as illustrated in FIGS. 24-27. In FIGS. 24-26, the light guiding region 2306 surrounds the sensor module 700, 800. In FIG. 27, the light guiding region 2306 partially surrounds the sensor module 700, 800. The light guiding region 2306 helps direct light to and/or from the sensor module 700, 800 and a blood flow region within the body part. In some embodiments, the light guiding region 2306 may be a reflector, such as a metal, metallic alloy, mylar, mica, reflective plastic, reflective textile, or the like. In other embodiments, the light guiding region 2306 may be a transparent light guide, such as transparent silicone, polymers, rubbers, textiles, glass, epoxies, glues, or the like. In the case of a reflective layer, the sensor module 700, 800 is at least partially exposed. In the case of a transparent light-guiding layer, the sensor module 700, 800 may be completely covered. Valencell at [0152].

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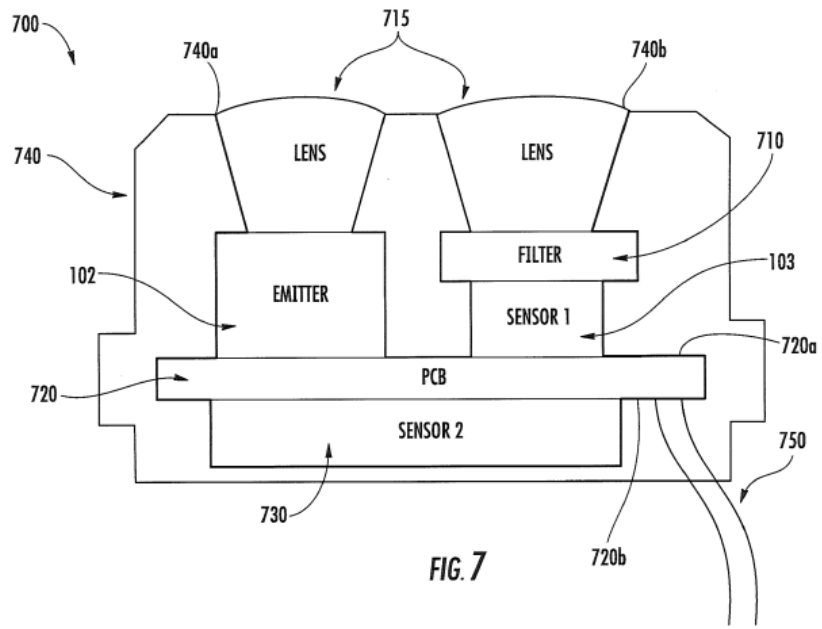
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	 FIG. 24 Valencell at fig. 24 Referring to FIGS. 28 and 29, the sensor module 700, 800 may be tilted with respect to a body part region (e.g., the wrist area) of a subject. In the illustrated embodiments of FIGS. 28 and 29, the sensor module 700, 800 is tilted towards the wrist (away from the upper arm). The embodiment illustrated in FIG. 28 has a light guiding region 2306 with a different configuration from the light guiding region 2306 illustrated in the embodiment of FIG. 29. The tilting of the sensor module 700, 800 serves at least the following functions: 1) protection from sunlight and 2) improvement of coupling between light from the sensor module 700, 800 and blood flow in the body part (i.e., wrist area). Sunlight immunity may be improved in this fashion because a human's wrist is typically pointed away from sunlight, and so pointing the sensor module down along the arm may help prevent environmental (i.e., sunlight) interference. Also, pointing the sensor module 700, 800 towards the wrist may increase the surface area of blood flow exposed to the sensor module 700, 800, thus increasing the blood flow signal intensity for PPG and the like. Valencell at [0153].

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Valencell discloses or renders obvious wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. In some embodiments of the present invention, the geometrical configuration of an emitter and detector may be oriented to maximize the collection of the energy response signal associated with physiological conditions and to minimize the collection of the unwanted scattered light response. Valencell at [0037]. Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy

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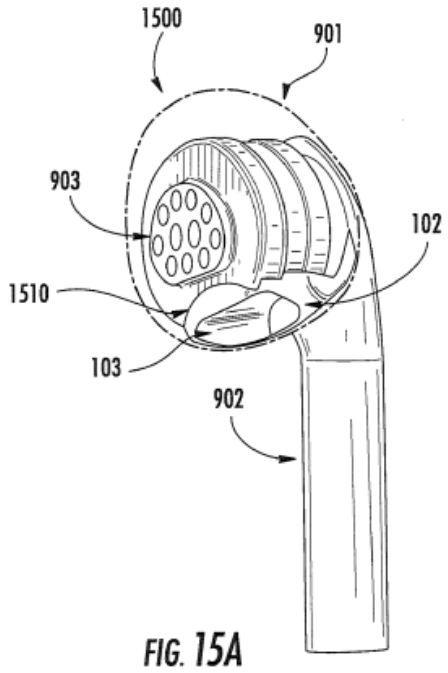
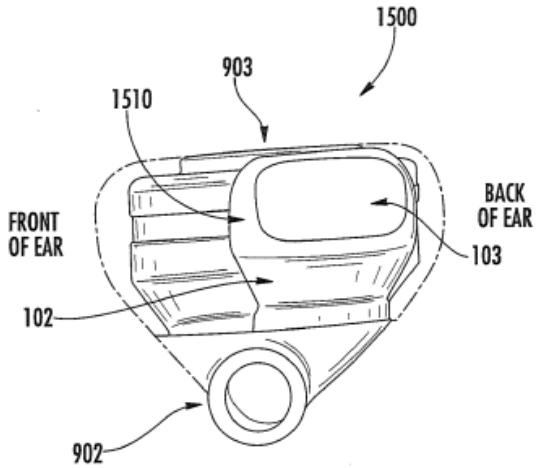
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	111. The optical source-detector assembly 201 may contain one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109]  FIG. 1 Valencell at Fig.1 As shown in FIGS. 7 and 8, the emitter 102 and detector 103 may be integrated within a circuit board 720 assembly, such as a printed circuit board (PCB) assembly. The PCB board 720 may have opposite first and second sides 720 a, 720 b, with at least one optical emitter and optical detector adjacent to each

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	other on the first side 720 a, and with at least one secondary sensor 730 on the second side 720 b. The secondary sensor 730 may be integrated within the PCB 720 for sensing another parameter. In one particular embodiment, the secondary sensor 730 may serve as a motion/position sensor 104 (FIG. 1). Connections or wiring 750 may be used to connect the sensor module 700 to another apparatus, connector, PCB, circuit, or the like. For example, electrical wiring or fiber optic cables may be overmolded such that sunlight cannot pass through the interface between the wires/cables and the overmold layer 740. Valencell at [0120]  FIG. 7 Valencell at Fig. 7 FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light

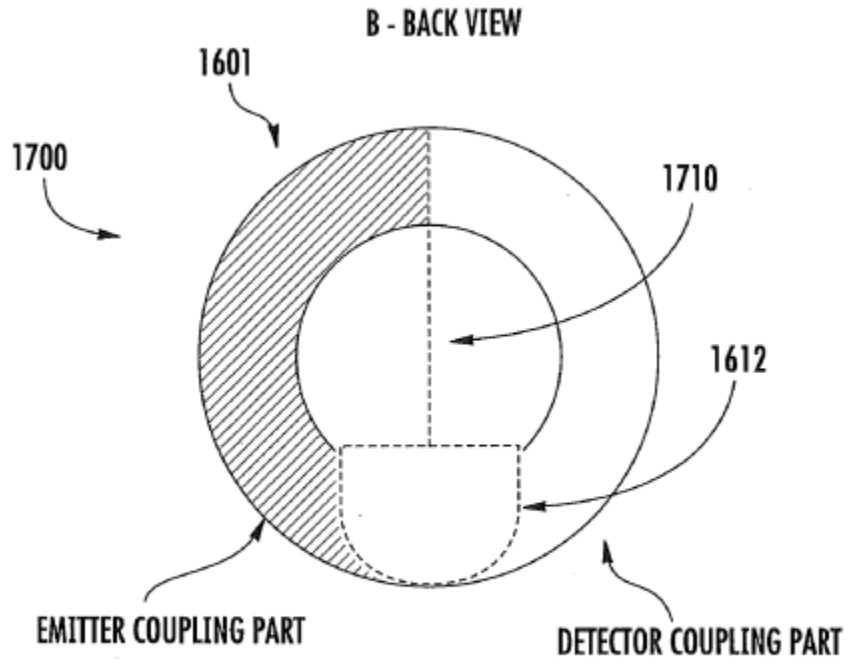
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	collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, collecting light at different wavelengths, and processing these signals collectively, can be used to generate assessments of blood gas levels, such as blood oxygen (SpO2) and carbon dioxide (SpCO2), blood hemoglobin types and levels, or other blood constituents and their respective concentration levels. Multiple wavelengths may be generated by a signal multiwavelength optical emitter, multiple optical emitters, optically filtered optical emitters, or the like. In such case, multiple optical emitters 102 may be located between the two optical filters 715. Valencell at [0130] FIGS. 15A-15B show a multi-detector earbud 1500, where two separate optical detectors 103 are covered by two separate optical lenses, at least one optical emitter is covered by at least one optical lens, and where the emitter 102 and detector 103 configuration is oriented perpendicularly to the antitragus (as that shown in FIG. 11). In FIGS. 15A-15B, the optical detectors 103, emitters 102, and lenses are not readily visible as they are surrounded, at least in part, by an optical coupling area 1510. The lenses (not shown) may cover each separate emitter 102 and detector 103 as shown in FIGS. 7 and 8. Note that in this configuration, the emitter- detector module 700, 800 of FIGS. 7 and 8 is oriented towards the back of the ear (near the back of the head). This arrangement may serve two purposes: 1) sunlight may be further blocked from reaching the detectors 103, as the back of the ear may serve as a shield and 2) there may be less motion artifacts convoluting the desired blood flow signals, as the detectors 103 may be oriented away from mouth-motion-prone areas located near the front of the ear. Another feature of the earbud 1500 of FIGS. 15A and 15B is that an optical coupling area 1510 is located on top of the optical emitter 102 and surrounding (but not covering) the optical detector 103. This optical coupling area 1510 may help diffuse, scatter, and/or guide light from the optical emitter to couple with a broader area of the ear region. Having a broader coupling area may help excite more regions of the ear with optical energy 110 (FIG. 1) and reduce the chance that the optical energy may miss important blood vessels, which may be located in different regions for different persons. Thus, such a design may promote a more universal design for a biometric earbud. Without an optical coupling area 1510, the optical energy 110 from the

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	optical emitter(s) 102 may miss blood vessels in different persons due to physiological differences that may exist between different people. Alternatively, the optical coupling area 1510 may be configured to cover the optical detector 103 area and not the optical emitter 102 area, such that more light is guided from different regions of the ear and coupled into the detector 103. Alternatively, a plurality of optical diffusion areas may be configured to cover the emitter 102 and detector 103 separately. Valencell at [0131]  FIG. 15A  FIG. 15B Valencell at fig 15a and 15b. Referring to FIG. 16B, in some embodiments of the present invention, emitter(s) and detector(s) may both be positioned in the earbud face 1605 region to direct light towards the earbud tip 1601. In this manner, the earbud tip 1601 may help: 1) direct light from the emitter to the ear region and 2) direct light from the ear region to the detector. However, optical scatter interference associated with light from an

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	emitter bouncing around in, around, and about the earbud tip 1601 may convolute a desired optical scatter signal (e.g., 111, FIG. 1) associated with physiological information (such as blood flow in the ear region). To reduce this unwanted convolution of undesired optical scatter, the earbud tip 1601 may include at least two separate parts, as shown in FIG. 17. The earbud tip 1601 illustrated in FIG. 17 is separated by an optical barrier 1710, with one part coupled to the optical emitter and another part coupled to the optical detector. Each part may support at least one separate optical path isolated by at least one optical barrier 1710. For example, one part may direct light from the emitter to the ear region and another part may direct light to the detector from the ear region. The optical barrier 1710 may be any material that is partially or completely opaque to the light wavelength of interest or any interface which reduces light transmission or communication between the two earbud tip parts. For example, the earbud tip 1601 may be molded from two (or more) separate materials (plastic, rubber, silicone, and the like) separated by: 1) an opaque material (plastic, rubber, silicone, paint, and the like) or 2) at least one interface between the two (or more) separate materials. The interface may be as simple as the natural interface between the two separate materials or as complex as by specially treating the interface by heat, light, abrasion, dissolving, chemical application, or the like. A roughened interface may help scatter light away from the interface and help keep the optical paths isolated within each respective part. It is important to note that such a multi-part earbud tip design may require a mating region 1612 to help align the earbud coupling part and detector coupling part with the emitter(s) and detector(s) respectively. As a further note, this design should not be limited to the two earbud tip parts (the emitter coupling part and detector coupling part) shown in FIG. 17. In one embodiment, multiple earbud tip parts may be employed to direct light from multiple separate emitters and/or multiple separate detectors located along the earbud housing 1901. Moreover, multiple separate materials may be used in each part, such that each part may provide different optical filtering or conditioning properties. Such a design may be particularly important for multiwavelength spectroscopy of the ear region. Valencell at [0136]

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	 FIG. 17 Valencell at Fig. 17 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

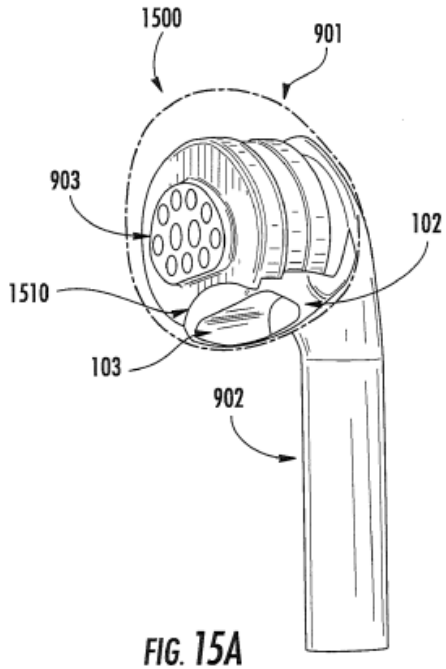
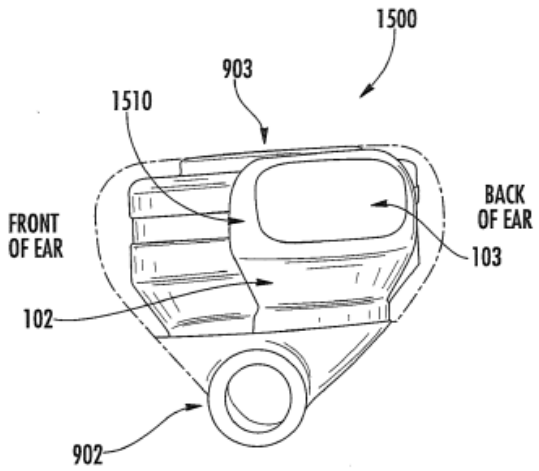
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	Claim 16
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Valencell discloses or renders obvious wherein the first arc and the second arc are concentric. In some embodiments of the present invention, the geometrical configuration of an emitter and detector may be oriented to maximize the collection of the energy response signal associated with physiological conditions and to minimize the collection of the unwanted scattered light response. Valencell at [0037]. FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, collecting light at different wavelengths, and processing these signals collectively, can be used to generate assessments of blood gas levels, such as blood oxygen (SpO2) and carbon dioxide (SpCO2), blood hemoglobin types and levels, or other blood constituents and their respective concentration levels. Multiple wavelengths may be generated by a signal multiwavelength optical emitter, multiple optical emitters, optically filtered optical emitters, or the like. In such case, multiple optical emitters 102 may be located between the two optical filters 715. Valencell at [0130] FIGS. 15A-15B show a multi-detector earbud 1500, where two separate optical detectors 103 are covered by two separate optical lenses, at least one optical emitter is covered by at least one optical lens, and where the emitter 102 and detector 103 configuration is oriented perpendicularly to the antitragus (as

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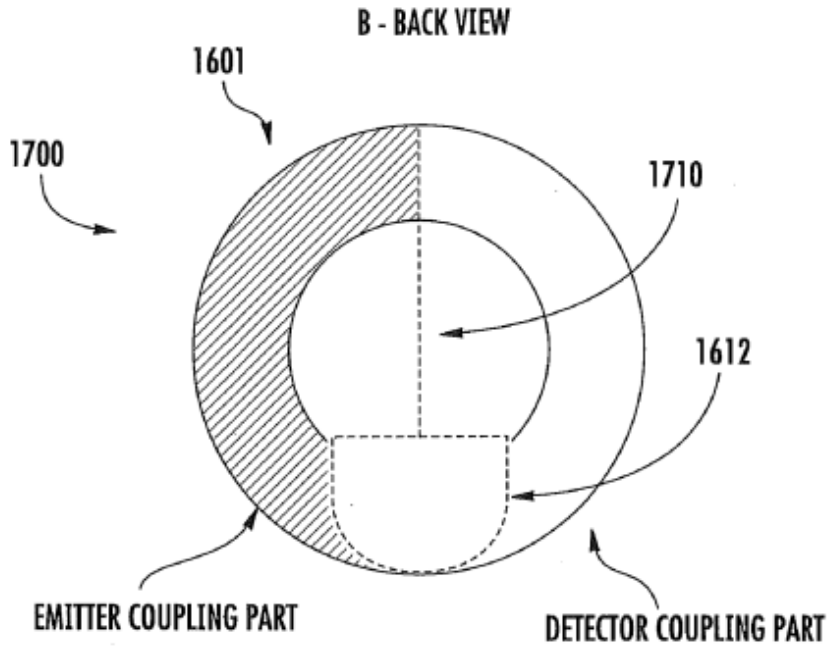
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	that shown in FIG. 11). In FIGS. 15A-15B, the optical detectors 103, emitters 102, and lenses are not readily visible as they are surrounded, at least in part, by an optical coupling area 1510. The lenses (not shown) may cover each separate emitter 102 and detector 103 as shown in FIGS. 7 and 8. Note that in this configuration, the emitter- detector module 700, 800 of FIGS. 7 and 8 is oriented towards the back of the ear (near the back of the head). This arrangement may serve two purposes: 1) sunlight may be further blocked from reaching the detectors 103, as the back of the ear may serve as a shield and 2) there may be less motion artifacts convoluting the desired blood flow signals, as the detectors 103 may be oriented away from mouth-motion-prone areas located near the front of the ear. Another feature of the earbud 1500 of FIGS. 15A and 15B is that an optical coupling area 1510 is located on top of the optical emitter 102 and surrounding (but not covering) the optical detector 103. This optical coupling area 1510 may help diffuse, scatter, and/or guide light from the optical emitter to couple with a broader area of the ear region. Having a broader coupling area may help excite more regions of the ear with optical energy 110 (FIG. 1) and reduce the chance that the optical energy may miss important blood vessels, which may be located in different regions for different persons. Thus, such a design may promote a more universal design for a biometric earbud. Without an optical coupling area 1510, the optical energy 110 from the optical emitter(s) 102 may miss blood vessels in different persons due to physiological differences that may exist between different people. Alternatively, the optical coupling area 1510 may be configured to cover the optical detector 103 area and not the optical emitter 102 area, such that more light is guided from different regions of the ear and coupled into the detector 103. Alternatively, a plurality of optical diffusion areas may be configured to cover the emitter 102 and detector 103 separately. Valencell at [0131]

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	 FIG. 15A  FIG. 15B Valencell at fig 15a and 15b. Referring to FIG. 16B, in some embodiments of the present invention, emitter(s) and detector(s) may both be positioned in the earbud face 1605 region to direct light towards the earbud tip 1601. In this manner, the earbud tip 1601 may help: 1) direct light from the emitter to the ear region and 2) direct light from the ear region to the detector. However, optical scatter interference associated with light from an emitter bouncing around in, around, and about the earbud tip 1601 may convolute a desired optical scatter signal (e.g., 111, FIG. 1) associated with physiological information (such as blood flow in the ear region). To reduce this unwanted convolution of undesired optical scatter, the earbud tip 1601 may include at least two separate parts, as shown in FIG. 17. The earbud tip 1601 illustrated in FIG. 17 is separated by an optical barrier 1710, with one part coupled to the optical emitter and another part coupled to the optical detector. Each part may support at least one separate optical path isolated by at least one optical barrier 1710. For example, one part may direct light from the emitter to the ear region and another part may direct light to the detector from the ear region. The optical barrier 1710 may be any material that is

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	partially or completely opaque to the light wavelength of interest or any interface which reduces light transmission or communication between the two earbud tip parts. For example, the earbud tip 1601 may be molded from two (or more) separate materials (plastic, rubber, silicone, and the like) separated by: 1) an opaque material (plastic, rubber, silicone, paint, and the like) or 2) at least one interface between the two (or more) separate materials. The interface may be as simple as the natural interface between the two separate materials or as complex as by specially treating the interface by heat, light, abrasion, dissolving, chemical application, or the like. A roughened interface may help scatter light away from the interface and help keep the optical paths isolated within each respective part. It is important to note that such a multi-part earbud tip design may require a mating region 1612 to help align the earbud coupling part and detector coupling part with the emitter(s) and detector(s) respectively. As a further note, this design should not be limited to the two earbud tip parts (the emitter coupling part and detector coupling part) shown in FIG. 17. In one embodiment, multiple earbud tip parts may be employed to direct light from multiple separate emitters and/or multiple separate detectors located along the earbud housing 1901. Moreover, multiple separate materials may be used in each part, such that each part may provide different optical filtering or conditioning properties. Such a design may be particularly important for multiwavelength spectroscopy of the ear region. Valencell at [0136]

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	 FIG. 17 Valencell at Fig. 17 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Valencell discloses or renders obvious a wearable device for use with a smart phone or tablet. *See* claim 11[a], 11[k] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant's Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	Valencell discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* claim 11[a] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical	Valencell discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelength. In some embodiments of the present invention, the energy emitter emits pulsed or modulated energy. Valencell at [0008]

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beam having one or more optical wavelengths, and	In some embodiments of the present invention, a physiological condition monitored, such as heart rate, for example, may be modulated to improve filtering and then demodulated to generate the desired output. Valencell at [0041] In some embodiments of the present invention, the energy emitter emits pulsed or modulated energy. Valencell at [0046] The term "modulated energy", as used herein, refers to energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc.) that is emitted in pulses and/or that is emitted such that the amplitude, frequency, phase, or intensity is varied. A pulsed energy source modulates by effectively multiplying by a waveform that is a periodic sequence of zeros and ones. Valencell at [0097] FIG. 1 illustrates an interference filtering apparatus/method 100, according to some embodiments of the present invention. A medium 130, preferably physiological material of a living subject, comprises at least one target region of interest 120 which is interrogated by energy 110, preferably modulated energy, such as pulsed energy, generated by an energy emitter 102. A pulsed driving circuit 101 is used to drive at least one energy emitter 102 at one or more pulsed frequencies to interrogate at least one target region of at least one medium 130 with the pulsed energy 110. The energy may be in the form of electromagnetic, acoustical, mechanical, nuclear, electrical, magnetic, thermal, or other forms of energy, but typically optical energy from the electromagnetic spectrum. The energy reaching the medium 130 can interact with the medium to generate at least one energy response signal 111, such as an optical scatter signal 111 between emitted optical energy 110 and the medium 130. The energy response 111 caused by this interaction is detected by at least one detector 103, configured to detect energy in the forms described above, but typically in the form of optical energy scattered from the medium 130. A motion/position sensor 104 may be configured to measure movement, positional changes, or inertial changes in the vicinity of the medium 130. The outputs of the detector 103 may be sent to at least one analog-to-digital convertor (ADC) 105 and the digitized output may be sent to at least one interference filter 106, which is configured to remove the effects of time-varying environmental interference 140

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	from the signal output of the detector 103. At least one motion/position sensor 104 may be incorporated in the interference filtering method 100 to provide a reference signal for removing the effects of motion from the extracted energy response signal 111 to produce a desired signal 109. For example, the output of the interference filter 106 may be further processed by signal extraction filter 107 to extract accurate information from the medium 130, and this signal extraction filter 107 may utilize the output of the motion/position sensor 104 to remove motion artifacts from the desired signal (the extracted energy response signal) 109. At least one signal processor (not shown) may be used to control the operations of the energy emitter 102, detector 103, filter 106, and/or other components of the interference filtering method 100. Valencell at [0107] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the

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	subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes.

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	In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109]. It should be noted that the modulated light 110 may be pulsed completely on or completely off, or it may be pulsed partially on or partially off. In some embodiments, for example, the modulated light may be sinusoidal. A benefit of complete on/off pulsing is that it may better-facilitate the signal processing methodologies outlined herein for attenuating environmental noise and motion-coupled environmental noise from one or more output signals. Valencell at [0143] A finite impulse response (FIR) version of an interference filter, according to some embodiments of the present invention, levering the pulsed-emitter on/off sampling rate, is presented in FIG. 20 and identified as 2000. The illustrated interference filter 2000 employs a delay of "n" samples according to Z−n. Coefficients in the filter "bn" allow multi-tap filtering. Pulsing an emitter (e.g., 102, FIG. 1) and selectively sampling on/off signals, as described herein, may modulate the physiological signal to a higher frequency. Thus, the output y(n) of the interference filter 2000 may be decimated to demodulate the output back into the baseband. A specific example of a decimation-by-2 algorithm may reject odd-numbered samples such that the decimated signal, w(m), may be described by even-numbered samples according to w(m)=y(2*m). Valencell at [0144] Examples of filters embodying the interference filter 2000, for removing sunlight interference from a PPG signal 1911 (FIGS. 19A, 19B) to extract heart rate, according to embodiments of the present invention, are illustrated in the plot 2100 of FIG. 21. The plot 2100 presents the magnitude response (in dB) for each interference filter vs. normalized frequency (1=Nyquist). Also shown in FIG. 21 is a representation of the modulated heart rate 2160 modulated by the emitter on/off sample rate, the demodulated heart rate 2140 demodulated by decimation, and the interference frequency associated with dynamic sunlight noise 2150. As a specific example for the previously described "subtraction filter" 2110, the FIR coefficients may be [b1 b2]=[1 −1]. A filter 2120 for subtracting the temporally

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	neighboring off-samples 1920, coming before and after a given on-sample 1930, may employ coefficients of [−0.05 1 −0.5]. A filter 2130 using multiple on/off samples may employ coefficients of [−0.07 0.3−0.6 0.6−0.3 0.07]. Valencell at [0145] It should be noted from FIG. 21 that interference filter 2000 may reject more unwanted sunlight than less complex filters. Because the dominant sunlight noise frequencies 2150 may be located at lower frequencies, and because the modulated heart rate signal frequency 2160 may be located at a much higher frequency, most or all of the sunlight noise 2150 may be rejected by the interference filter 2130. Then through demodulation in further-processing (e.g., 107, FIG. 1), the heart rate signal may be returned to the baseband so that real-time heart rate may be extracted. Valencell at [0146] An interference filtering method, according to some embodiments of the present invention, may employ a motion/position sensor (e.g., 104, FIG. 1) to further remove interference from a desired physiological signal (e.g., 109, FIG. 1). For the case of sunlight interference (e.g., 140, FIG. 1) on an earbud sensor module (e.g., 207, FIG. 2), outdoor sunlight may more strongly illuminate an ear and detector 103 in the sensor module 207 than the emitter 102 in the sensor module 207. While an interference filter (e.g., 2130, FIG. 21) may effectively remove the baseband frequencies of this interference, harmonics caused by motion-induced sunlight noise may dominate the digitized signal near the frequencies of the modulated desired information (e.g., 2160, FIG. 21). The step rate of a person running or jogging may be the strongest component of this interference. Moreover, because a person running or jogging may be moving through varying sunlight intensity, the interference signal may be a convolution of motion-coupled-sunlight changes in time. A technique for removing sunlight interference, according to some embodiments of the present invention, utilizes a motion or position sensor (e.g., 104, FIG. 1), such as an inertial sensor, accelerometer, pedometer, gyroscope, microelectromechanical sensor, capacitive sensor, inductive sensor, optical motion sensor, or the like. The step rate may be measured as the peak frequency in the spectrum of the signal coming from motion/position sensor 104 or as the frequency of the spectral peak of the signal coming from the motion/position sensor 104. For example, the processed spectrum may employ differentiation or integration to generate a processed motion/position signal, and the peak frequency of this processed spectrum may be more indicative of the step rate. Harmonics and aliased harmonics of the step rate may determine the frequencies of interference to ignore in the desired-

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	information spectrum. For example, the emitter pulse rate minus eight times the step rate (aliased 8th harmonic) may be the frequency of strong interference in the frequency space of the modulated heart rate (e.g., 2160, FIG. 21), and frequencies within a pre-determined range may be set to zero in the desired-information spectrum. Valencell at [0147 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Valencell discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* claim 11[c], 11[e], 19[a] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are	Valencell discloses or renders obvious the measurement device further comprising a receiver configured to:capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue.

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off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue.	*See* claim 11[d], 11[h], 11[i], 19[a] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Valencell discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor sources. *See* claim 11[a], 11[b], 11[g], 19[a], 19[b], 19[d] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Valencell discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* claim 11[b], 11[h], 11[i], 11[j], 19[a], 19[d] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading. .
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Valencell discloses or renders obvious increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* claim 11[a] , 11[b], 19[a] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Valencell discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* claim 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or	Valencell discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen.

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tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	*See* claim 11[k], 19[pre] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link	Valencell discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link. *See* claim 11[k], 19[pre] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of	Valencell discloses or renders obvious wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 13, 19 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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the plurality of semiconductor sources from an initial non-zero pulse rate.	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Valencell discloses or renders obvious wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Valencell discloses or renders obvious wherein the first arc and the second arc are concentric. *See* claim 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D14

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EXHIBIT D15

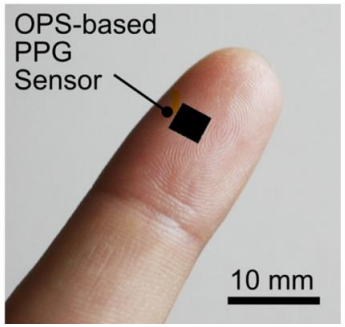
U.S. Pat. No. 10,874,304 in view of "Plug-and-Play, Single-Chip Photoplethysmography" to Deepak Chandrasekar et al. ("Chandrasekar2012")

As described in detail below, Chandrasekar2012 (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either alone in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D14 and D16-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Chandrasekar2012. The cited portions of Chandrasekar2012 are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Chandrasekar2012. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Chandrasekar2012 "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Chandrasekar2012 does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Chandrasekar2012 (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Chandrasekar2012 anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

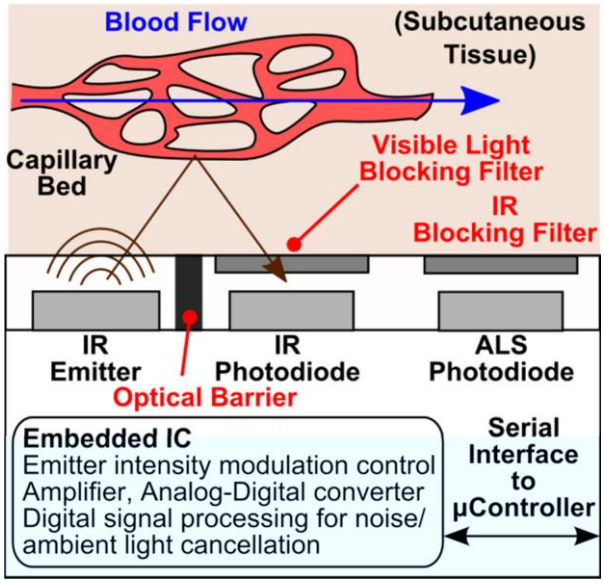
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 1	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Chandrasekar2012 discloses or renders obvious a measurement system. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for “plug- and-play” PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column.  Chandrasekar2012 at Fig. 1.

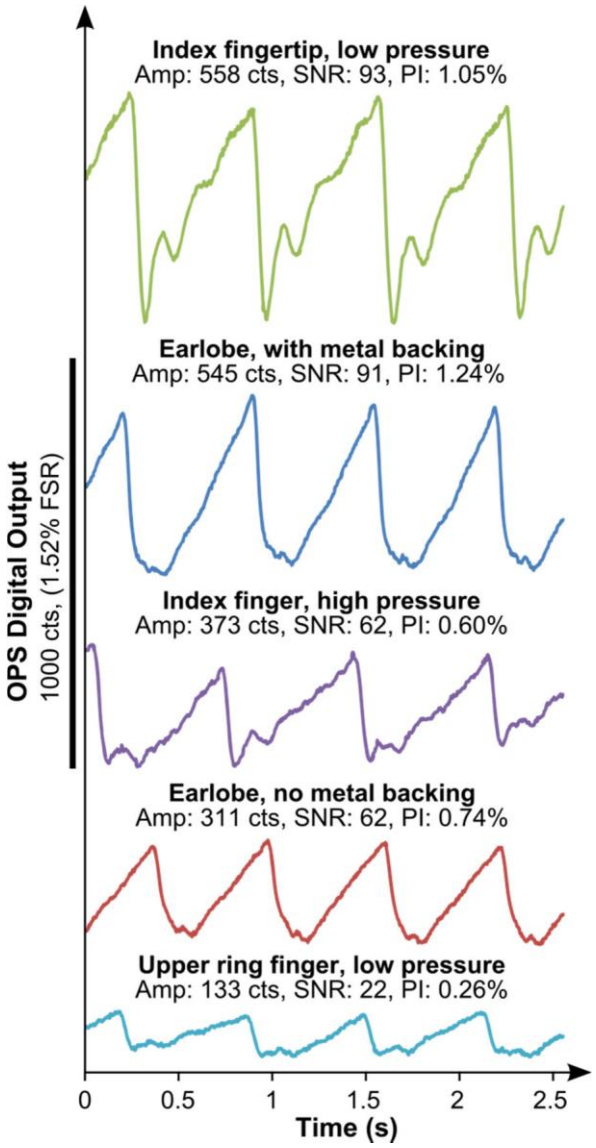
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	Photoplethsymography (PPG) is a ubiquitous monitoring technique for measuring heart rate and oxygen saturation. PPG sensors detect blood volume pulsations by time- resolved analysis of optical radiation either absorbed or scattered by a capillary bed [3]. In principle, PPGs are considered simple devices; however, in practice, implementation requires a careful design involving optics (multiple paths, alignments, leakage barriers) and mixed signal electronics (transimpedance amplifiers, analog digital conversion, drivers, modulators, filters). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. As a result, designing a robust PPG sensor requires a engineering effort and investment. Chandrasekar2012 at pg. 3243 right column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column.

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	 Chandrasekar2012 at Fig. 2. PPGs are obtained by placing the sensor at a fixed pressure with the skin at multiple locations, including the index finger, earlobe, and upper ring finger. In the earlobe measurements, a metal backing is placed on the opposite side to improve the reflectance signal. Before performing the measurement, the current for the IR emitter is manually set to a value approximately 75% of the dynamic range of the sensor. This maintains a large reflected light signal while minimizing the likelihood of detector saturation. The SNR is found to scale proportionally with the reflected light. The ideal current setting is found to be between 80-130 mA, depending on the anatomical location and the individual being tested. Chandrasekar2012 at pg. 3245 left and right columns. Experiments show that the OPS sensor can produce high quality PPGs in multiple anatomical locations (Figure 4). The signal amplitude ranges from 130-560 counts within a full scale range of 216. Pulsation

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	indices (PIs) vary from 0.26-1.25%, which is typical for reflectance pulse oximetry, and is well within the resolution of the 16 bit ADC. The SNR varies between 20-90 depending on the location and the applied pressure. This is comparable or better than existing PPG sensors, which typically have SNR between 30-50. The index fingertip provides the largest overall signal amplitude and SNR, while the earlobe with metal backing gives the largest PI. Heart rate can be easily calculated from the PPG waveforms using computationally inexpensive signal processing algorithms such as time derivatives, averaging windows, or infinite impulse response (IIR) filters implemented on the microcontroller [3]. Chandrasekar2012 at pg. 3245 right column and 3246 left column.

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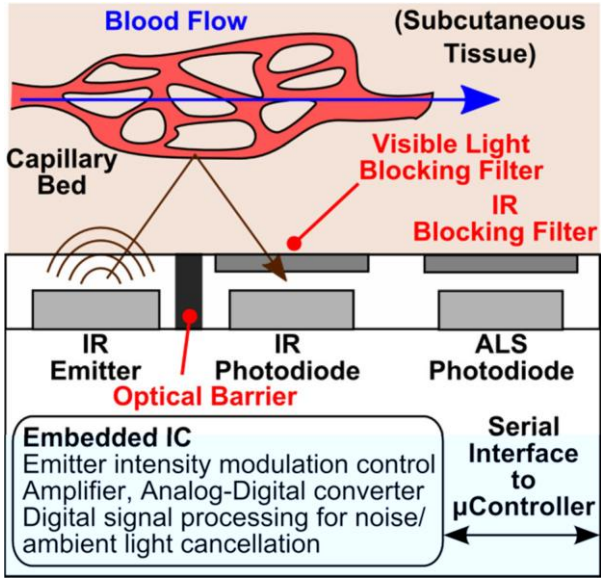
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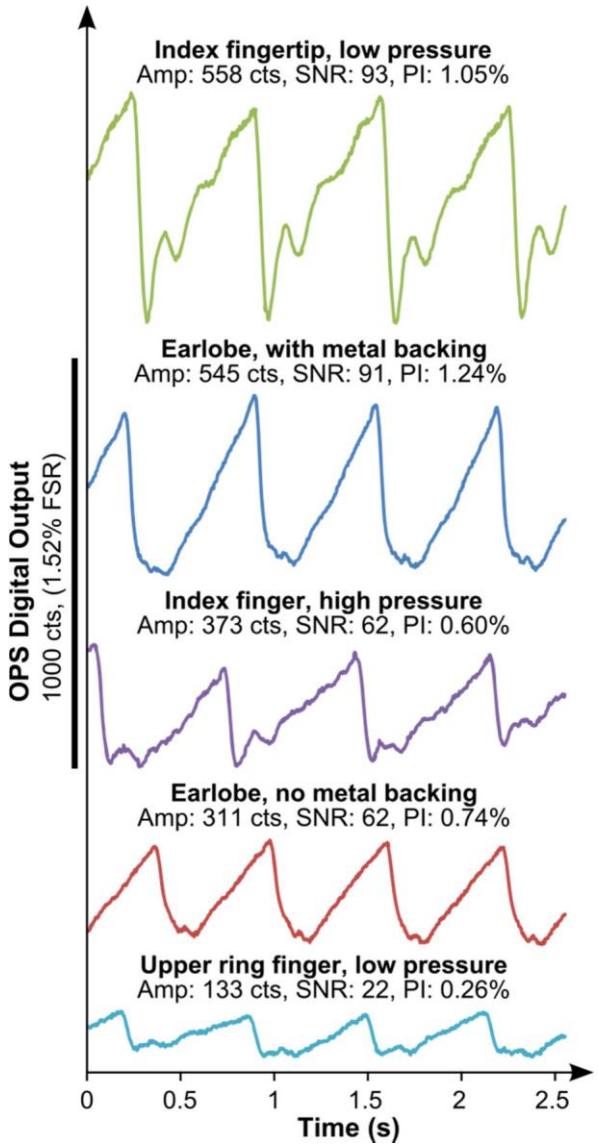
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	Chandrasekar2012 at Fig. 4. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Chandrasekar2012 discloses or renders obvious a wearable measurement device for measuring one or more Chandrasekar2012 discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for "plug- and-play" PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 μW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors' knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column.

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	Remote patient monitoring (RPM), a rapidly emerging paradigm in chronic disease management [1], relies on ambulatory biosensors to assess patients’ physiological indicators on a continual basis. Chandrasekar2012 at pg. 3243 left column. Photoplethsymography (PPG) is a ubiquitous monitoring technique for measuring heart rate and oxygen saturation. PPG sensors detect blood volume pulsations by time- resolved analysis of optical radiation either absorbed or scattered by a capillary bed [3]. Chandrasekar2012 at pg. 3243 right column. In other words, the ideal sensor should function out of the box without additional components, provide a digital interface to a microcontroller for configuration and data transfer. It should also be small and low cost. The most successful recent example is the microaccelerometer, which has seen rapid, pervasive growth in the smartphone, automotive safety, and home entertainment markets. Chandrasekar2012 at pg. 3243 right column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column.

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	Heart rate can be easily calculated from the PPG waveforms using computationally inexpensive signal processing algorithms such as time derivatives, averaging windows, or infinite impulse response (IIR) filters implemented on the microcontroller [3]. Chandrasekar2012 at pg. 3245 right column and 3246 left column. In this paper, we show how a digital OPS can be used as a high-performance, reflectance-mode PPG sensor (Figure 2). The OPS is placed in direct contact with the skin near a capillary bed, such as the fingertip, earlobe, or forehead. A transparent protective overlay can be added if desired. The IR LED emits light into the tissue, where it experiences diffuse reflection from the tissue and capillary bed. This establishes a baseline reflectance signal which is detected at the PD. When a pulse wave propagates through the capillary bed, the reflectance signal falls slightly (0.5-5%) due to light scattering. The change is detected by the PD and processed by embedded amplification and signal processing circuitry. Chandrasekar2012 at pg. 3244 left and right columns.  Chandrasekar2012 at Fig. 2.

’304 Patent	Chandrasekar2012
	We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. The sensor includes an I2C serial interface, and the cost is <$2 USD. The sensor data is recorded using a Silicon Labs microcontroller connected to a laptop via USB. Chandrasekar2012 at pg. 3245 left column.

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	 Chandrasekar2012 at Fig. 4.

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	It is notable that the OPS-based device provides better performance in most categories, particularly those of interest in wearable sensors. These include substantial improvements in power (10X), size (12X), cost (5-10X), and signal to noise ratio (2-3X). To the authors' knowledge, this is the smallest and lowest power single-wavelength PPG sensor currently available. Another advantage is that the sensor provides an industry standard I2C digital interface to a microcontroller. This link allows for device configuration and data transfer, thus making it simple to integrate a high performance, single-chip PPG sensor into a microcontroller- based embedded system. Chandrasekar2012 at pg. 3246 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b] the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Chandrasekar2012 discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 μW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors' knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column.

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’304 Patent	Chandrasekar2012
	In principle, PPGs are considered simple devices; however, in practice, implementation requires a careful design involving optics (multiple paths, alignments, leakage barriers) and mixed signal electronics (transimpedance amplifiers, analog digital conversion, drivers, modulators, filters). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. As a result, designing a robust PPG sensor requires a engineering effort and investment. A complete sensor typically requires 10-20 components, 1.5-10mW power, and costs >$20 USD. Chandrasekar2012 at pg. 3243 right column. Improved sensitivity due to small PD-LED spacing. One of the challenges in reflectance mode PPG is that <5% of the light is backscattered to the detector. The intensity of the backscattered light, which forms a concentric ring around the excitation LED [4,8], falls off as the square of the distance (Figure 3). Therefore, it is critical to maintain a small distance between the LED and PD. In a digital OPS, the distance is <1-2 mm, compared to >5mm in a typical PPG [9-10]. This increases the reflected light (and therefore, signal to noise ratio) by a factor of 5-25x. Chandrasekar2012 at pg. 3244 right column. Intensity control. To maximize the signal to noise ratio in PPG, the LED intensity should be made as large as possible without saturating the detector. In a digital OPS, the LED intensity is programmable through the serial interface, allowing closed loop control to prevent detector saturation. Chandrasekar2012 at pg. 3245 left column. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until

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the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate.

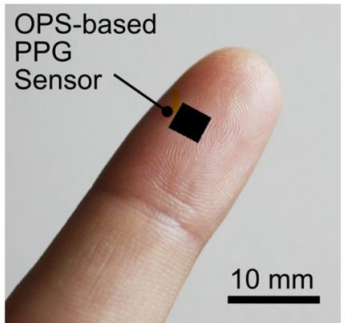
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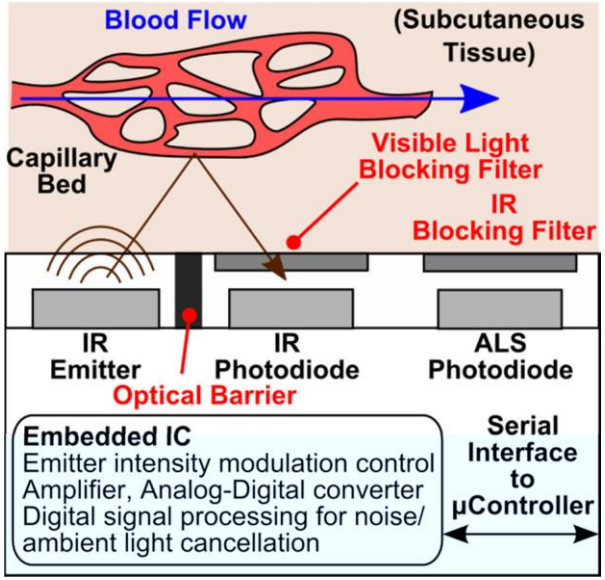
Table 1 further compares the performance of the digital OPS reported in this paper with state-of-the art PPG sensors reported in both the research and commercial sectors. It is notable that the OPS-based device provides better performance in most categories, particularly those of interest in wearable sensors. These include substantial improvements in power (10X), size (12X), cost (5-10X), and signal to noise ratio (2-3X). To the authors’ knowledge, this is the smallest and lowest power single-wavelength PPG sensor currently available. Another advantage is that the sensor provides an industry standard I2C digital interface to a microcontroller. This link allows for device configuration and data transfer, thus making it simple to integrate a high performance, single-chip PPG sensor into a microcontroller- based embedded system. These features, along with the low cost ($2 USD), make the sensor well-suited for wearable and mobile health monitoring.

TABLE I. COMPARISON OF DIGITAL OPTICAL PROXIMITY SENSOR-BASED PPG SENSOR WITH CONVENTIONAL PPG TECHNOLOGY

Performance Parameter	**Existing PPGs (best case)** [3–4],[8], [12-13]	**OPS-based PPG**
# of Components	>10	1
PCB Area	200 mm^2	16 mm^2
Power Consumption	1.5-10 mW	200 µW (100mA, 10 Hz)
Cost:	$15-20 USD	$2 USD
Supply Voltage	3V/5V	3V
Sensor Output	Analog	Digital (I^2C serial)
Max. Data Rate	200 Hz	1000 Hz
LED, PD spacing	4-6 mm	1-2 mm
Noise rejection features	Bandpass filter: 0.5-5 Hz	Electronic noise cancellation @3.125 MHz
IR filter	Not included	Integrated
SNR	20-30	Up to 95
Wavelength	650-950 nm	895 nm (can be changed)

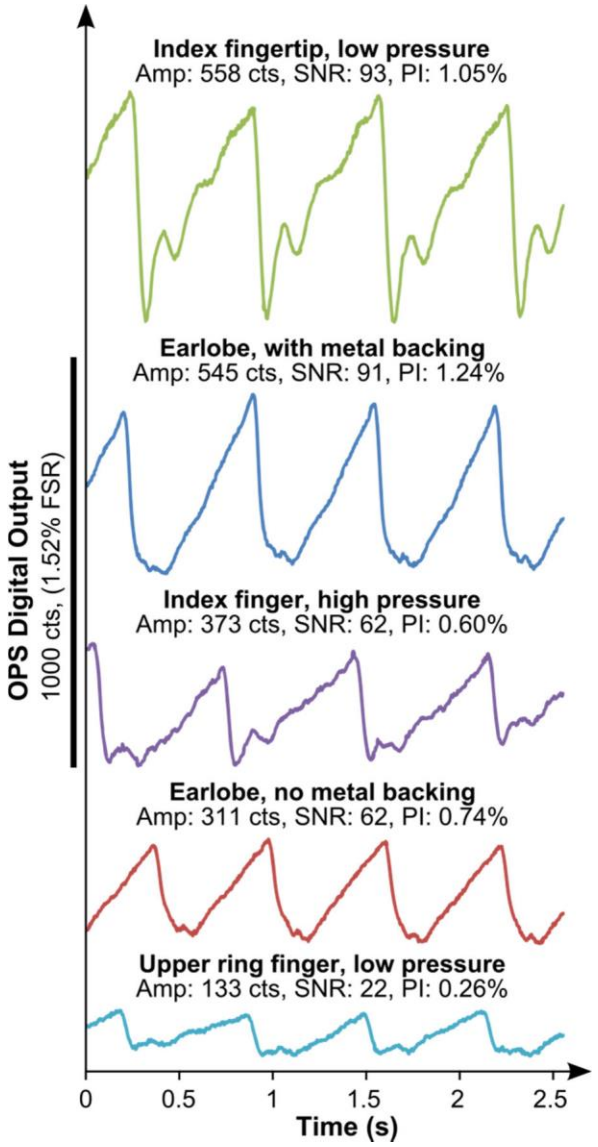
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	Chandrasekar2012 at pg. 3246 right column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c] the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Chandrasekar2012 discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for “plug- and-play” PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column.

’304 Patent	Chandrasekar2012
	 Chandrasekar2012 at Fig. 1. Photoplethsymography (PPG) is a ubiquitous monitoring technique for measuring heart rate and oxygen saturation. PPG sensors detect blood volume pulsations by time- resolved analysis of optical radiation either absorbed or scattered by a capillary bed [3]. In principle, PPGs are considered simple devices; however, in practice, implementation requires a careful design involving optics (multiple paths, alignments, leakage barriers) and mixed signal electronics (transimpedance amplifiers, analog digital conversion, drivers, modulators, filters). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. As a result, designing a robust PPG sensor requires a engineering effort and investment. Chandrasekar2012 at pg. 3243 right column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also

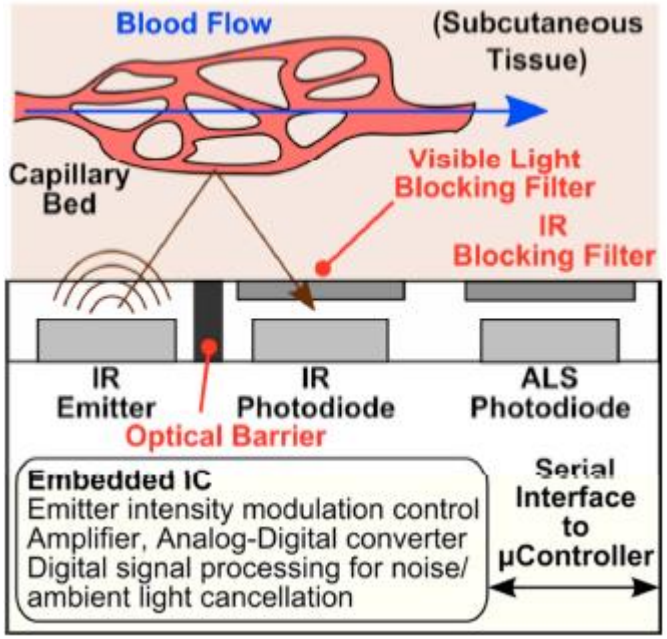
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	provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column.  Chandrasekar2012 at Fig. 2. PPGs are obtained by placing the sensor at a fixed pressure with the skin at multiple locations, including the index finger, earlobe, and upper ring finger. In the earlobe measurements, a metal backing is placed on the opposite side to improve the reflectance signal. Before performing the measurement, the current for the IR emitter is manually set to a value approximately 75% of the dynamic range of the sensor. This maintains a large reflected light signal while minimizing the likelihood of detector saturation. The SNR is found to scale proportionally with the reflected light. The ideal current setting is found to be between 80-130 mA, depending on the anatomical location and the individual being tested.

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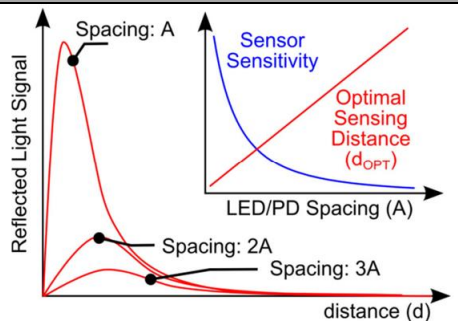
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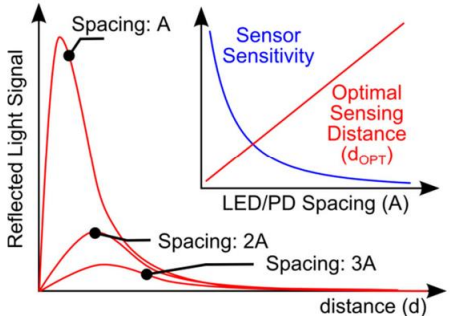
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11[d] the wearable measurement device further comprising a receiver configured to:	Chandrasekar2012 discloses or renders obvious the wearable measurement device further comprising a receiver. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for "plug- and-play" PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 μW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors' knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety

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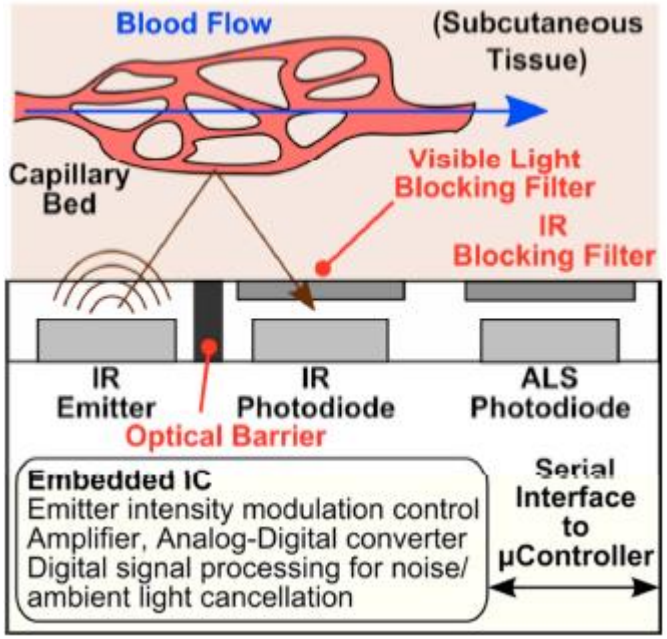
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	 Chandrasekar2012 at Fig. 3. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e] receive and process at least a portion of the analysis output beam reflected or transmitted from the sample,	Chandrasekar2012 discloses or renders obvious the wearable measurement device further comprising the receiver configured to: receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for “plug- and-play” PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers,

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	filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column. Improved sensitivity due to small PD-LED spacing. One of the challenges in reflectance mode PPG is that <5% of the light is backscattered to the detector. The intensity of the backscattered light, which forms a concentric ring around the excitation LED [4,8], falls off as the square of the distance (Figure 3). Therefore, it is critical to maintain a small distance between the LED and PD. In a digital OPS, the distance is <1-2 mm, compared to >5mm in a typical PPG [9-10]. This increases the reflected light (and therefore, signal to noise ratio) by a factor of 5-25x. Chandrasekar2012 at pg. 3244 right column.

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	Digital Interface. Many digital OPS include an industry standard I2C serial bus, which provides a bidirectional link to a microcontroller for data transmission and configuration. The digital output is inherently more noise immune than an analog interface, and allows multiple sensors on a single bus. Chandrasekar2012 at pg. 3245 left column. PPGs are obtained by placing the sensor at a fixed pressure with the skin at multiple locations, including the index finger, earlobe, and upper ring finger. In the earlobe measurements, a metal backing is placed on the opposite side to improve the reflectance signal. Before performing the measurement, the current for the IR emitter is manually set to a value approximately 75% of the dynamic range of the sensor. This maintains a large reflected light signal while minimizing the likelihood of detector saturation. The SNR is found to scale proportionally with the reflected light. Chandrasekar2012 at pg. 3245 left and right columns.  Chandrasekar2012 at Fig. 3. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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11[f] generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Chandrasekar2012 discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. Abstract — Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Chandrasekar2012 at pg. 3243 left column. Remote patient monitoring (RPM), a rapidly emerging paradigm in chronic disease management [1], relies on ambulatory biosensors to assess patients’ physiological indicators on a continual basis. Chandrasekar2012 at pg. 3243 left column. Photoplethsymography (PPG) is a ubiquitous monitoring technique for measuring heart rate and oxygen saturation. PPG sensors detect blood volume pulsations by time- resolved analysis of optical radiation either absorbed or scattered by a capillary bed [3]. In principle, PPGs are considered simple devices; however, in practice, implementation requires a careful design involving optics (multiple paths, alignments, leakage barriers) and mixed signal electronics (transimpedance amplifiers, analog digital conversion, drivers, modulators, filters). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. Chandrasekar2012 at pg. 3243 right column.

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	 Chandrasekar2012 at Fig. 2. In this paper, we show how a digital OPS can be used as a high-performance, reflectance-mode PPG sensor (Figure 2). The OPS is placed in direct contact with the skin near a capillary bed, such as the fingertip, earlobe, or forehead. A transparent protective overlay can be added if desired. The IR LED emits light into the tissue, where it experiences diffuse reflection from the tissue and capillary bed. This establishes a baseline reflectance signal which is detected at the PD. When a pulse wave propagates through the capillary bed, the reflectance signal falls slightly (0.5-5%) due to light scattering. The change is detected by the PD and processed by embedded amplification and signal processing circuitry. Chandrasekar2012 at pg. 3244 left and right columns. Experiments show that the OPS sensor can produce high quality PPGs in multiple anatomical locations (Figure 4). The signal amplitude ranges from 130-560 counts within a full scale range of 216. Pulsation indices (PIs) vary from 0.26-1.25%, which is typical for reflectance pulse oximetry, and is well within the resolution of the 16 bit ADC. The SNR varies between 20-90 depending on the location and the

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	applied pressure. This is comparable or better than existing PPG sensors, which typically have SNR between 30-50. The index fingertip provides the largest overall signal amplitude and SNR, while the earlobe with metal backing gives the largest PI. Heart rate can be easily calculated from the PPG waveforms using computationally inexpensive signal processing algorithms such as time derivatives, averaging windows, or infinite impulse response (IIR) filters implemented on the microcontroller [3]. Chandrasekar2012 at pg. 3245 right column and 3246 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g] synchronize to the light source,	Chandrasekar2012 discloses or renders obvious the receiver configured to synchronize to the light source. Photoplethsymography (PPG) is a ubiquitous monitoring technique for measuring heart rate and oxygen saturation. PPG sensors detect blood volume pulsations by time- resolved analysis of optical radiation either absorbed or scattered by a capillary bed [3]. In principle, PPGs are considered simple devices; however, in practice, implementation requires a careful design involving optics (multiple paths, alignments, leakage barriers) and mixed signal electronics (transimpedance amplifiers, analog digital conversion, drivers, modulators, filters). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. Chandrasekar2012 at pg. 3243 right column. Electronic noise and offset cancellation. Conventional PPGs require a bandpass filter to avoid 60/120 Hz noise from ambient light. This can limits the bandwidth of the sensor, making it difficult to resolve high frequency features of the pressure pulse. In a digital OPS, the LED emitter is pulsed at a high frequency (>1 MHz) which is an integer multiple of 60 Hz. The signal processing circuitry utilizes a

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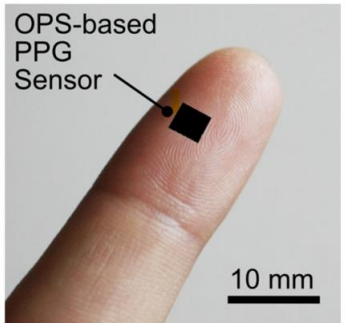
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	demodulation scheme, similar to lock-in-detection [11], which eliminates ambient light artifacts and 1/f noise. This enables fast measurement rates while maintaining low noise. Chandrasekar2012 at pg. 3245 left column. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. Chandrasekar2012 at pg. 3245 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h] capture light while the semiconductor sources are off and convert the captured light into a first signal,	Chandrasekar2012 discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also

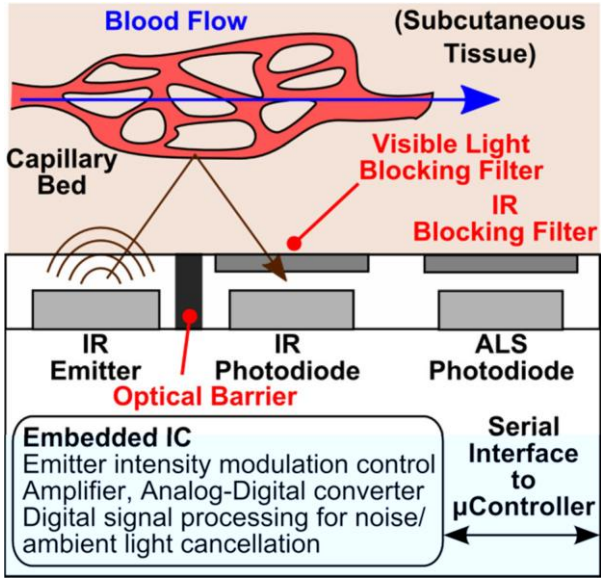
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	used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column. Electronic noise and offset cancellation. Conventional PPGs require a bandpass filter to avoid 60/120 Hz noise from ambient light. This can limits the bandwidth of the sensor, making it difficult to resolve high frequency features of the pressure pulse. In a digital OPS, the LED emitter is pulsed at a high frequency (>1 MHz) which is an integer multiple of 60 Hz. The signal processing circuitry utilizes a demodulation scheme, similar to lock-in-detection [11], which eliminates ambient light artifacts and 1/f noise. This enables fast measurement rates while maintaining low noise. Chandrasekar2012 at pg. 3245 left column. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I^2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Chandrasekar2012 at pg. 3245 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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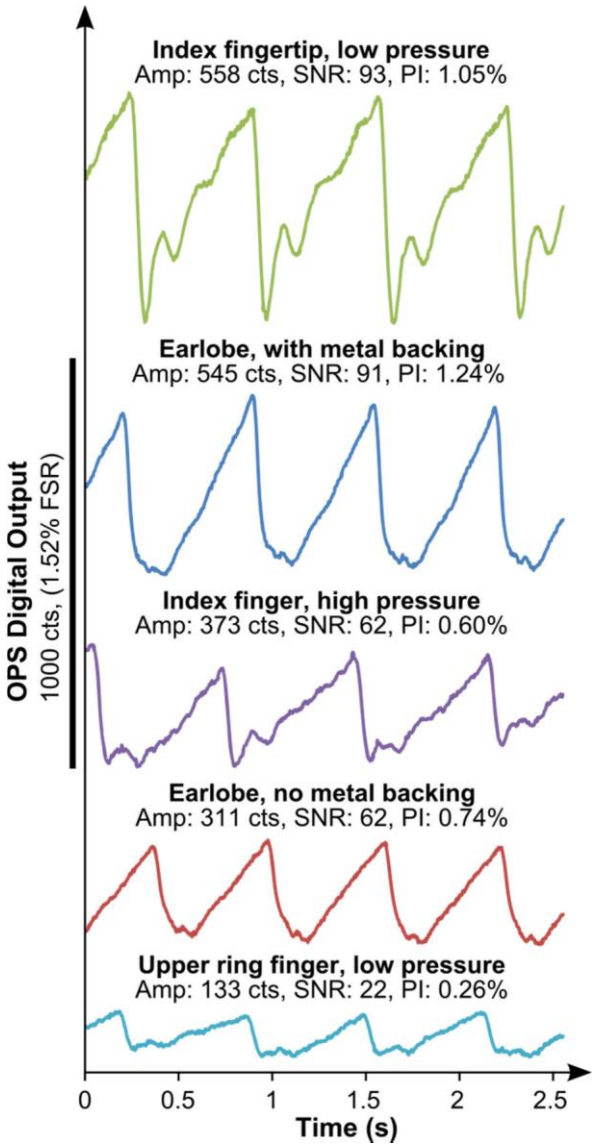
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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i] capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Chandrasekar2012 discloses or renders obvious the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for “plug- and-play” PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 μW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column.

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	 Chandrasekar2012 at Fig. 1. Photoplethsymography (PPG) is a ubiquitous monitoring technique for measuring heart rate and oxygen saturation. PPG sensors detect blood volume pulsations by time- resolved analysis of optical radiation either absorbed or scattered by a capillary bed [3]. In principle, PPGs are considered simple devices; however, in practice, implementation requires a careful design involving optics (multiple paths, alignments, leakage barriers) and mixed signal electronics (transimpedance amplifiers, analog digital conversion, drivers, modulators, filters). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. As a result, designing a robust PPG sensor requires a engineering effort and investment. Chandrasekar2012 at pg. 3243 right column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also

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	provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column.  Chandrasekar2012 at Fig. 2. PPGs are obtained by placing the sensor at a fixed pressure with the skin at multiple locations, including the index finger, earlobe, and upper ring finger. In the earlobe measurements, a metal backing is placed on the opposite side to improve the reflectance signal. Before performing the measurement, the current for the IR emitter is manually set to a value approximately 75% of the dynamic range of the sensor. This maintains a large reflected light signal while minimizing the likelihood of detector saturation. The SNR is found to scale proportionally with the reflected light. The ideal current setting is found to be between 80-130 mA, depending on the anatomical location and the individual being tested.

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	Chandrasekar2012 at pg. 3245 left and right columns. Experiments show that the OPS sensor can produce high quality PPGs in multiple anatomical locations (Figure 4). The signal amplitude ranges from 130-560 counts within a full scale range of 216. Pulsation indices (PIs) vary from 0.26-1.25%, which is typical for reflectance pulse oximetry, and is well within the resolution of the 16 bit ADC. The SNR varies between 20-90 depending on the location and the applied pressure. This is comparable or better than existing PPG sensors, which typically have SNR between 30-50. The index fingertip provides the largest overall signal amplitude and SNR, while the earlobe with metal backing gives the largest PI. Heart rate can be easily calculated from the PPG waveforms using computationally inexpensive signal processing algorithms such as time derivatives, averaging windows, or infinite impulse response (IIR) filters implemented on the microcontroller [3]. Chandrasekar2012 at pg. 3245 right column and 3246 left column.

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	Chandrasekar2012 at Fig. 4. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. Chandrasekar2012 at pg. 3245 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j] wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Chandrasekar2012 discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological

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	monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. In principle, PPGs are considered simple devices; however, in practice, implementation requires a careful design involving optics (multiple paths, alignments, leakage barriers) and mixed signal electronics (transimpedance amplifiers, analog digital conversion, drivers, modulators, filters). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. As a result, designing a robust PPG sensor requires a engineering effort and investment. A complete sensor typically requires 10-20 components, 1.5-10mW power, and costs >$20 USD. Chandrasekar2012 at pg. 3243 right column. Improved sensitivity due to small PD-LED spacing. One of the challenges in reflectance mode PPG is that <5% of the light is backscattered to the detector. The intensity of the backscattered light, which forms a concentric ring around the excitation LED [4,8], falls off as the square of the distance (Figure 3). Therefore, it is critical to maintain a small distance between the LED and PD. In a digital OPS, the distance is <1-2 mm, compared to >5mm in a typical PPG [9-10]. This increases the reflected light (and therefore, signal to noise ratio) by a factor of 5-25x. Chandrasekar2012 at pg. 3244 right column. Intensity control. To maximize the signal to noise ratio in PPG, the LED intensity should be made as large as possible without saturating the detector. In a digital OPS, the LED intensity is programmable through the serial interface, allowing closed loop control to prevent detector saturation. Chandrasekar2012 at pg. 3245 left column. Table 1 further compares the performance of the digital OPS reported in this paper with state-of-the art PPG sensors reported in both the research and commercial sectors. It is notable that the OPS-based device provides better performance in most categories, particularly those of interest in wearable sensors. These include substantial improvements in power (10X), size (12X), cost (5-10X), and signal to noise ratio (2-

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3X). To the authors’ knowledge, this is the smallest and lowest power single-wavelength PPG sensor currently available. Another advantage is that the sensor provides an industry standard I2C digital interface to a microcontroller. This link allows for device configuration and data transfer, thus making it simple to integrate a high performance, single-chip PPG sensor into a microcontroller- based embedded system. These features, along with the low cost ($2 USD), make the sensor well-suited for wearable and mobile health monitoring.

TABLE I. COMPARISON OF DIGITAL OPTICAL PROXIMITY SENSOR-BASED PPG SENSOR WITH CONVENTIONAL PPG TECHNOLOGY

Performance Parameter	**Existing PPGs (best case)** [3–4],[8], [12-13]	**OPS-based PPG**
# of Components	>10	1
PCB Area	200 mm^2	16 mm^2
Power Consumption	1.5-10 mW	200 µW (100mA, 10 Hz)
Cost:	$15-20 USD	$2 USD
Supply Voltage	3V/5V	3V
Sensor Output	Analog	Digital (I^2C serial)
Max. Data Rate	200 Hz	1000 Hz
LED, PD spacing	4-6 mm	1-2 mm
Noise rejection features	Bandpass filter: 0.5-5 Hz	Electronic noise cancellation @3.125 MHz
IR filter	Not included	Integrated
SNR	20-30	Up to 95
Wavelength	650-950 nm	895 nm (can be changed)

Chandrasekar2012 at pg. 3246 right column.

One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the

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	teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	Chandrasekar2012 discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for "plug- and-play" PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors' knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. In other words, the ideal sensor should function out of the box without additional components, provide a digital interface to a microcontroller for configuration and data transfer. It should also be small and low cost. The most successful recent example is the microaccelerometer, which has seen rapid, pervasive growth in the smartphone, automotive safety, and home entertainment markets. Chandrasekar2012 at pg. 3243 right column.

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	Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. Chandrasekar2012 at pg. 3244 left column. Digital Interface. Many digital OPS include an industry standard I^2C serial bus, which provides a bidirectional link to a microcontroller for data transmission and configuration. The digital output is inherently more noise immune than an analog interface, and allows multiple sensors on a single bus. Chandrasekar2012 at pg. 3245 left column. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. The sensor includes an I2C serial interface, and the cost is <$2 USD. The sensor data is recorded using a Silicon Labs microcontroller connected to a laptop via USB. Chandrasekar2012 at pg. 3245 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Chandrasekar2012 discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for “plug- and-play” PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. Remote patient monitoring (RPM), a rapidly emerging paradigm in chronic disease management [1], relies on ambulatory biosensors to assess patients’ physiological indicators on a continual basis.

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	Chandrasekar2012 at pg. 3243 left column. In other words, the ideal sensor should function out of the box without additional components, provide a digital interface to a microcontroller for configuration and data transfer. It should also be small and low cost. The most successful recent example is the microaccelerometer, which has seen rapid, pervasive growth in the smartphone, automotive safety, and home entertainment markets. Chandrasekar2012 at pg. 3243 right column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. Chandrasekar2012 at pg. 3244 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Chandrasekar2012 discloses or renders obvious the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Chandrasekar2012 discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. *See* claim 11 above. Table 1 further compares the performance of the digital OPS reported in this paper with state-of-the art PPG sensors reported in both the research and commercial sectors. It is notable that the OPS-based device provides better performance in most categories, particularly those of interest in wearable sensors. These include substantial improvements in power (10X), size (12X), cost (5-10X), and signal to noise ratio (2-3X). To the authors’ knowledge, this is the smallest and lowest power single-wavelength PPG sensor currently available. Another advantage is that the sensor provides an industry standard I2C digital interface to a microcontroller. This link allows for device configuration and data transfer, thus making it simple to integrate a high performance, single-chip PPG sensor into a microcontroller- based embedded system. These features, along with the low cost ($2 USD), make the sensor well-suited for wearable and mobile health monitoring.

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<table>
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<tr><td></td><td>
TABLE I. COMPARISON OF DIGITAL OPTICAL PROXIMITY SENSOR-BASED PPG SENSOR WITH CONVENTIONAL PPG TECHNOLOGY
<table>
<tr><th>Performance Parameter</th><th>Existing PPGs (best case) [3–4],[8], [12-13]</th><th>OPS-based PPG</th></tr>
<tr><td># of Components</td><td>>10</td><td>1</td></tr>
<tr><td>PCB Area</td><td>200 mm^2</td><td>16 mm^2</td></tr>
<tr><td>Power Consumption</td><td>1.5-10 mW</td><td>200 µW (100mA, 10 Hz)</td></tr>
<tr><td>Cost:</td><td>$15-20 USD</td><td>$2 USD</td></tr>
<tr><td>Supply Voltage</td><td>3V/5V</td><td>3V</td></tr>
<tr><td>Sensor Output</td><td>Analog</td><td>Digital (I^2C serial)</td></tr>
<tr><td>Max. Data Rate</td><td>200 Hz</td><td>1000 Hz</td></tr>
<tr><td>LED, PD spacing</td><td>4-6 mm</td><td>1-2 mm</td></tr>
<tr><td>Noise rejection features</td><td>Bandpass filter: 0.5-5 Hz</td><td>Electronic noise cancellation @3.125 MHz</td></tr>
<tr><td>IR filter</td><td>Not included</td><td>Integrated</td></tr>
<tr><td>SNR</td><td>20-30</td><td>Up to 95</td></tr>
<tr><td>Wavelength</td><td>650-950 nm</td><td>895 nm (can be changed)</td></tr>
</table>

Chandrasekar2012 at pg. 3246 right column.

One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
</td></tr>
<tr><td>12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the</td><td>Chandrasekar2012 discloses or renders obvious the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.</td></tr>
</table>

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measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	*See* claim 11 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Chandrasekar2012 discloses or renders obvious the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. Intensity control. To maximize the signal to noise ratio in PPG, the LED intensity should be made as large as possible without saturating the detector. In a digital OPS, the LED intensity is programmable through the serial interface, allowing closed loop control to prevent detector saturation. Chandrasekar2012 at pg. 3245 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein	Chandrasekar2012 discloses or renders obvious the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser

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the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11, 11[a], 11[e] above. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column. Improved sensitivity due to small PD-LED spacing. One of the challenges in reflectance mode PPG is that <5% of the light is backscattered to the detector. The intensity of the backscattered light, which forms a concentric ring around the excitation LED [4,8], falls off as the square of the distance (Figure 3). Therefore, it is critical to maintain a small distance between the LED and PD. In a digital OPS, the distance is <1-2 mm, compared to >5mm in a typical PPG [9-10]. This increases the reflected light (and therefore, signal to noise ratio) by a factor of 5-25x. Reduced background due to optical barrier. A drawback of a small LED-PD spacing is light leakage, which increases the baseline PPG signal. Digital OPS include an optical barrier between the LED and PD which substantially reduces light leakage [9] and thereby improves SNR. This is particularly important in “zero-distance detection” where the skin is in direct contact with the sensor [10]. Chandrasekar2012 at pg. 3244 right column.

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	We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. Chandrasekar2012 at pg. 3245 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Chandrasekar2012 discloses or renders obvious the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. See claim 11 above. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector

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	amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. The sensor includes an I2C serial interface, and the cost is <$2 USD. The sensor data is recorded using a Silicon Labs microcontroller connected to a laptop via USB. Chandrasekar2012 at pg. 3244 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Chandrasekar2012 discloses or renders obvious the first arc and the second arc are concentric. *See* claim 15 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	

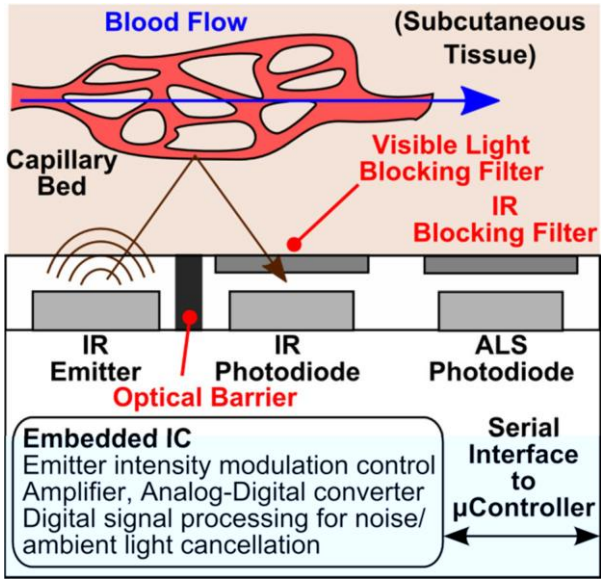
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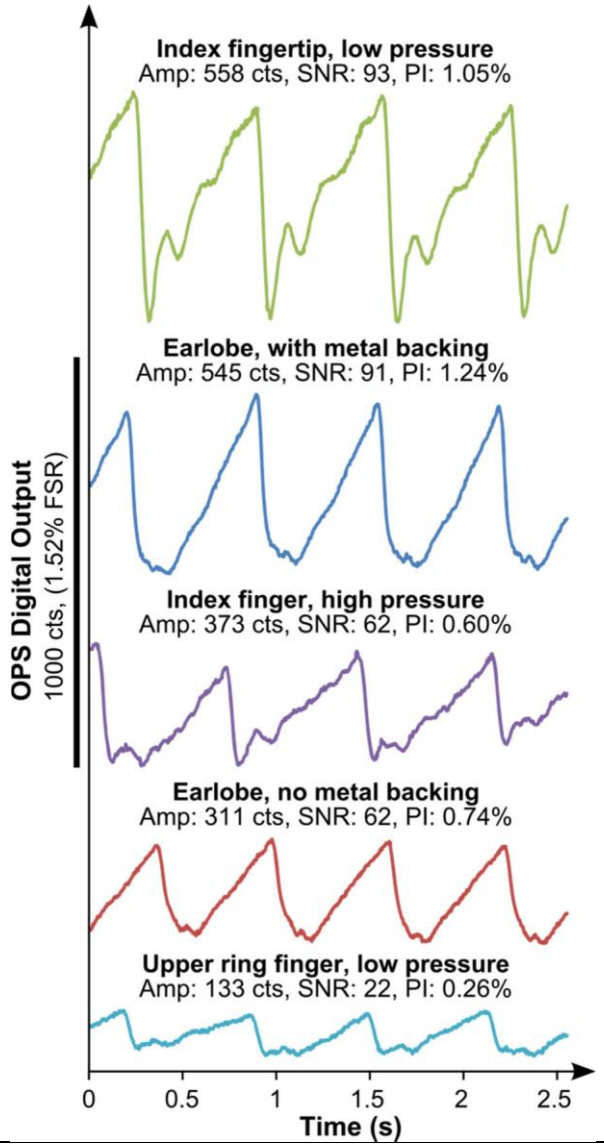
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19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Chandrasekar2012 discloses or renders obvious a wearable device for use with a smart phone or tablet, the wearable device. *See* 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,:	Chandrasekar2012 discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical	Chandrasekar2012 discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the

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beam having one or more optical wavelengths, and	principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for “plug- and-play” PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column.

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	 Chandrasekar2012 at Fig. 2. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. The sensor includes an I2C serial interface, and the cost is <$2 USD. The sensor data is recorded using a Silicon Labs microcontroller connected to a laptop via USB.

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	Chandrasekar2012 at Fig. 4. It is notable that the OPS-based device provides better performance in most categories, particularly those of interest in wearable sensors. These include substantial improvements in power (10X), size (12X), cost (5-10X), and signal to noise ratio (2-3X). To the authors' knowledge, this is the smallest and lowest power single-wavelength PPG sensor currently available. Another advantage is that the sensor provides an industry standard I2C digital interface to a microcontroller. This link allows for device configuration and data transfer, thus making it simple to integrate a high performance, single-chip PPG sensor into a microcontroller- based embedded system. Chandrasekar2012 at pg. 3246 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Chandrasekar2012 discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the

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	teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;	Chandrasekar2012 discloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue. *See* 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Chandrasekar2012 discloses or renders obvious the receiver configured tosynchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise	Chandrasekar2012 discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal.

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ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	*See* 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Chandrasekar2012 discloses or renders obvious the measurement device further configured increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[a], 11[b], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Chandrasekar2012 discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 11[a], 11[f], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Chandrasekar2012 discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link.	Chandrasekar2012 discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, and store and display the processed output signal, transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	

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20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Chandrasekar2012 discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claims 19, 13 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Chandrasekar2012 discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claims 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first	Chandrasekar2012 discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric.

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arc and the second arc are concentric.	*See* claims 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D16

U.S. Pat. No. 10,874,304 in view of U.S. Patent No. 7,507,207 to Kazuhiro Sakai et al. ("Sakai")

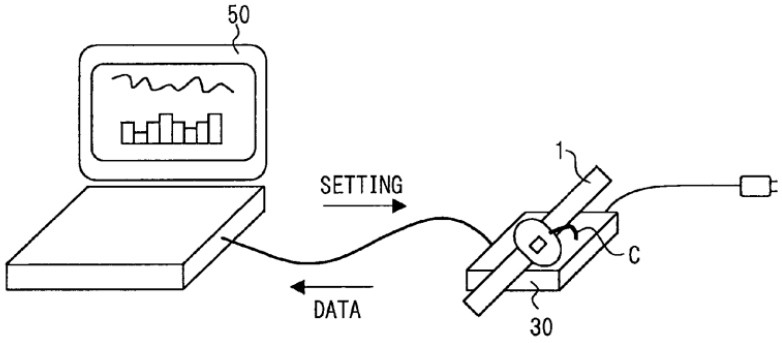
As described in detail below, Sakai (individually or collectively) anticipates and/or renders obvious claims 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D15 and D17-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

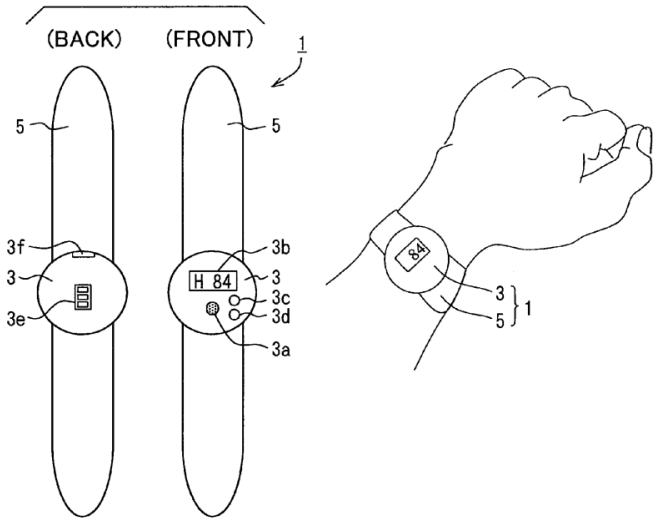
The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Sakai. The cited portions of Sakai are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Sakai. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Sakai "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Sakai does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Sakai (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Sakai anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

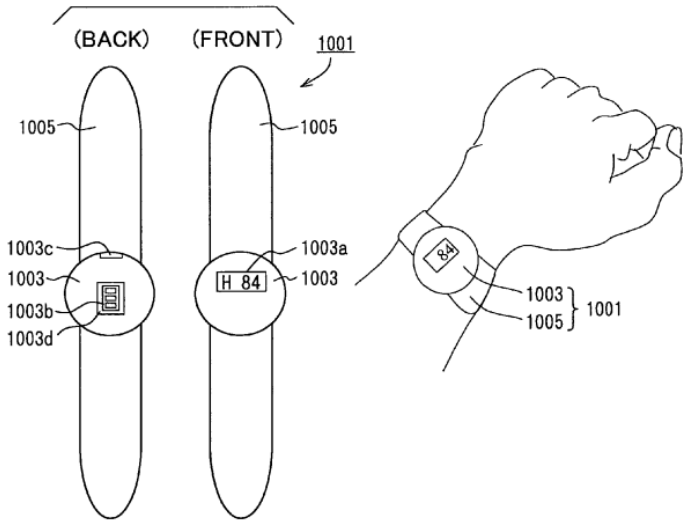
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Claim 11	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Sakai discloses or renders obvious a measurement system. In **a portable biological information monitor apparatus**, a pulse wave detection signal obtained by light emission from **a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information**. **This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake**. **In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep.** Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone. Sakai at [Abstract] In **the portable biological information monitor apparatus** according to the present invention made to attain the above object, biological information detection means repeatedly **detects a test subject's biological information reflecting pulse, body motion, and autonomic nervous system function**. Then, barometer generation means includes multiple generation modes corresponding to the test subject's actions and operates in any of generation modes based on the detected biological information. Here, the generation modes include at least a first generation mode to generate sleep evaluation barometers for evaluation of the test subject's status in sleep and a second generation mode to generate wake evaluation barometers for evaluation of the test subject's status in wake. Storage means stores the generated barometers. “Barometer” is used to mean an “indicator. Sakai at 2:4-18 In this manner, **the portable biological information monitor apparatus** according to the present invention, as a single apparatus, monitors biological information in sleep and biological information in wake. **Then, a comprehensive evaluation of the test subject's status (e.g., life rhythm, activity amount (consumed calories), physical condition, and sleep quality) can be made based on sleep**

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	evaluation barometers and wake evaluation barometers generated from these pieces of biological information. Further, accurate advice can be dispensed to the test subject based on the result of evaluation. Sakai at 2:19-29. **As shown in FIG. 1, the physical condition management system** of the present embodiment **has a portable biological information monitor apparatus 1 (hereinbelow, simply referred to as a “monitor”) which is attached to a test subject as the subject of management when the apparatus is used; a charger 30 which charges the monitor 1 and interfaces communication with the monitor 1 via a cable C attachable to and removable from the monitor 1; and an information management unit 50 which performs communication with the monitor 1 via the charger 30 to thereby change internal settings of the monitor 1, and performs various processings based on data obtained from the monitor 1**. Sakai at 4:16-27 FIG. 1  Sakai at Fig.1 FIGS. 2A and 2B are explanatory views showing the arrangement of the monitor and the monitor apparatus in use**. As shown in FIG. 2A, the monitor 1 has a main body 3 formed to approximately**

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	have a size of wrist watch, and a belt-type attachment portion 5 integrally formed with the main body 3. Sakai at 4:49-53. FIG. 2A FIG. 2B  Sakai at Fig. 2A and 2B. **An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3.** Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1. Sakai at 4:54-62

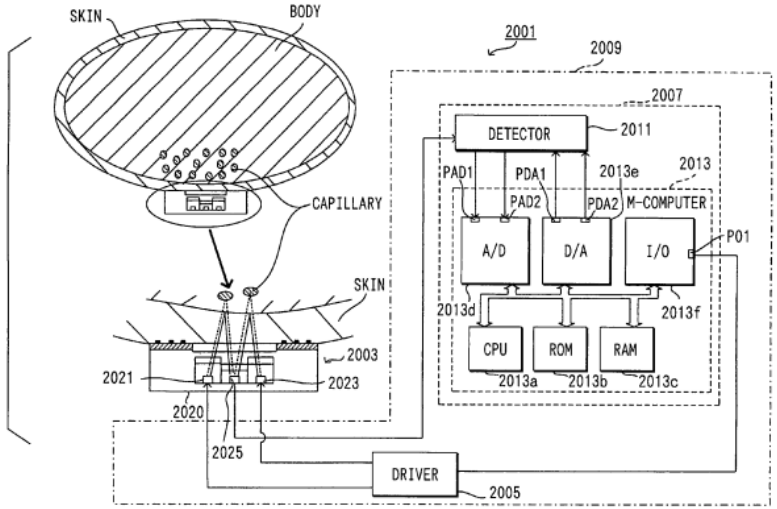
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	As shown in FIGS. 12A and 12B, a biological status detection apparatus 1001 of the present embodiment has a main body 1003 formed to approximately have a size of wrist watch, and a belt-type attachment portion 1005 integrally formed with the main body 1003. Sakai at 16:38-42. FIG. 12A FIG. 12B  Sakai at Fig. 12a and 12b. **A display panel 1003 a is provided on the front surface of the main body 1003. A light transmitting plate 1003 b forming a detection window for transmitting light used in detection of biological information, and a connector 1003 c for connection with a cable C for communication with an external device and for charging the apparatus are provided on the back surface of the main body 1003.** Sakai at 16:43-49

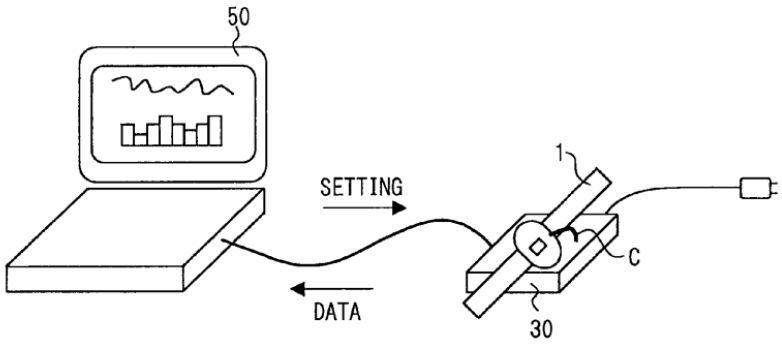
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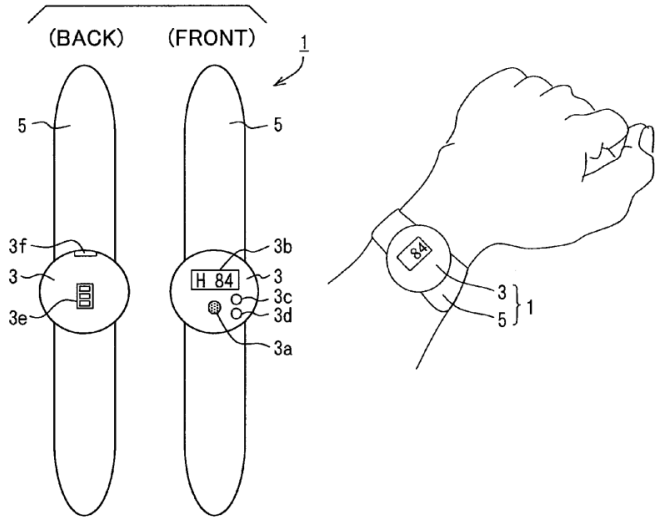
’304 Patent	Sakai
	When the biological status detection apparatus 1001 is used, as shown in FIG. 12B, the apparatus is fixed around a test subject's wrist or ankle with the attachment portion 1005 such that the back surface of the main body 1003 where the light transmitting plate 1003 b is formed is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from finger tip to root of all limbs. Further, the attachment portion 1005 may be a supporter member in place of the belt. Sakai at 16:50-58. **A pulse wave detection apparatus 2001 according to the present embodiment detects a human body's pulse rate**. **As shown in FIG. 31, the pulse wave detection apparatus 2001 has a pulse wave sensor 2003 including an infrared LED 2021 and a green LED 2023 as light emission devices; a photo diode (PD) 2025 as a photoreception device; a driver 2005 which drives the pulse wave sensor 2003 by outputting driving signals to the infrared LED 2021 and the green LED 2023 to emit light at different timings; and a data processing unit 2007 which processes a signal from the pulse wave sensor 2003 and controls the driver 2005. Note that the driver 2005 and the data processing unit 2007 are accommodated in a casing of a pulse wave detection apparatus main body 2009.** Sakai at 28:1-13

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’304 Patent	Sakai
	FIG. 31  Sakai at Fig. 31. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an	Sakai discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths. In **a portable biological information monitor apparatus**, **a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information**. **This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's**

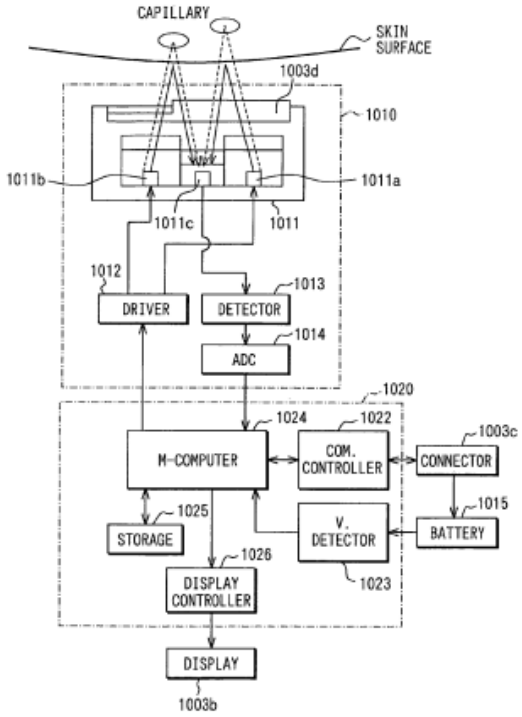
’304 Patent	Sakai
output optical beam with one or more optical wavelengths;	**status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] In this manner, **the portable biological information monitor apparatus according to the present invention, as a single apparatus, monitors biological information in sleep and biological information in wake. Then, a comprehensive evaluation of the test subject's status (e.g., life rhythm, activity amount (consumed calories), physical condition, and sleep quality) can be made based on sleep evaluation barometers and wake evaluation barometers generated from these pieces of biological information. Further, accurate advice can be dispensed to the test subject based on the result of evaluation.** Sakai at 2:19-28 Further, according to the present invention, **as barometers for evaluation of different actions (sleep evaluation barometers and wake evaluation barometers) are generated from the same biological information, attachment and removal of apparatuses by action is not necessary**. Further, as the apparatus itself is a portable type apparatus which does not limit the test subject's actions, **biological information in normal living conditions can be easily obtained without the test subject's consciousness of measurement.** Sakai at 2:29-37 As shown in FIG. 1, **the physical condition management system of the present embodiment has a portable biological information monitor apparatus 1 (hereinbelow, simply referred to as a “monitor”) which is attached to a test subject** as the subject of management when the apparatus is used; a charger 30 which charges the monitor 1 and interfaces communication with the monitor 1 via a cable C attachable to and removable from the monitor 1; and an information management unit 50 which

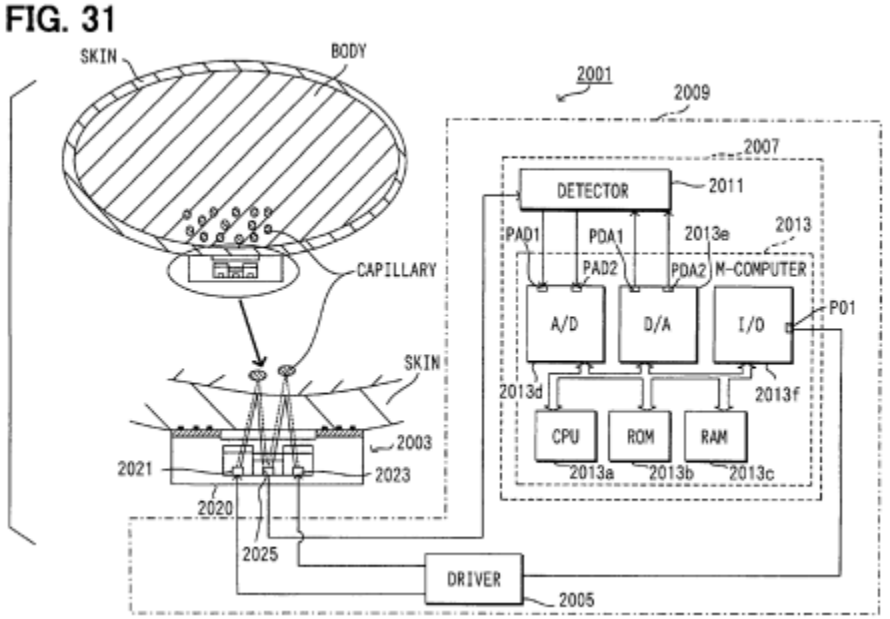
’304 Patent	Sakai
	performs communication with the monitor 1 via the charger 30 to thereby change internal settings of the monitor 1, and performs various processings based on data obtained from the monitor 1. Sakai at 4:16-27 FIG. 1  Sakai at Fig. 1 FIGS. 2A and 2B are explanatory views showing the arrangement of the monitor and the monitor apparatus in use. **As shown in FIG. 2A, the monitor 1 has a main body 3 formed to approximately have a size of wrist watch, and a belt-type attachment portion 5 integrally formed with the main body 3.** An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3. Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1. Sakai at 4:49-62

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	FIG. 2A FIG. 2B  Sakai at Fig. 2A and 2B The information detection unit 10 has an optical pulse wave and **body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b;** a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20; a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. Sakai at 5:13-24 Note that **when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body,** a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light.

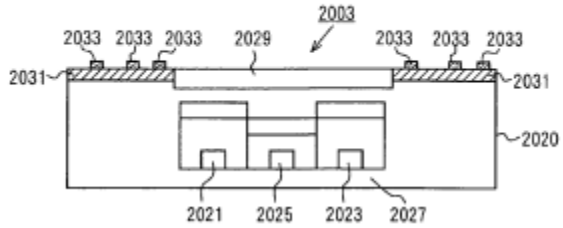
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	Sakai at 5:25-30 Further, in the above embodiment, **the sensor having the green LED 11 a and the infrared LED 11 b is employed for biological information detection**; however, it may be arranged such that a sensor only having the green LED 11 a is used and pulse component and body motion component are extracted from a pulse wave detection signal. Sakai at 14:53-58 Further, an apparatus using an optical pulse wave sensor to emit two types of lights having different wavelengths is known (e.g., see JP-H7-88092 A (U.S. Pat. No. 6,022,321)). The apparatus discriminates a pulse component from a body motion component and detects exercise intensity of the living body or the like, from a ratio and the change of rate between amplitudes of peak frequency components included in the respective detection signals. **The detection signals are detected using the lights having different wavelengths.** Here, two facts are utilized, i.e, the first fact that the light absorption characteristic of blood component changes in correspondence with light wavelength, and the second fact that the motion of living body influences blood flow rate. Sakai at 16:3-15 **The information detection unit 1010 has an optical pulse wave sensor 1011 having a green LED 1011 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 1011 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm**), and a photo diode (PD) 1011 c to receive reflected light from the LEDs 1011 a and 1011 b; a driver 1012 which drives the LEDs 1011 a and 1011 b in accordance with instructions from the information processor 1020; a detector 1013 which drives the PD 1011 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 1014 which converts the detection signal from the detector 1013 into digital data. Sakai at 17:12-24

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’304 Patent	Sakai
	FIG. 13  Sakai at Fig. 13 A pulse wave detection apparatus 2001 according to the present embodiment detects a human body's pulse rate. **As shown in FIG. 31, the pulse wave detection apparatus 2001 has a pulse wave sensor 2003 including an infrared LED 2021 and a green LED 2023 as light emission devices;** a photo diode (PD) 2025 as a photoreception device; a driver 2005 which drives the pulse wave sensor 2003 by outputting driving signals to the infrared LED 2021 and the green LED 2023 to emit light at different timings; and a data processing unit 2007 which processes a signal from the pulse wave sensor 2003 and controls the driver 2005. Note that the driver 2005 and the data processing unit 2007 are accommodated in a casing of a pulse wave detection apparatus main body 2009.

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	Sakai at 28:1-13  Sakai at Fig. 31 The pulse wave sensor 2003 is fixed to human body's arm or the like when it is used. **As shown in FIG. 32A, the pulse wave sensor is an optical reflective type sensor having the infrared LED 2021 to emit infrared light having a wavelength of about 940 nm, the green LED 2023 to emit green light having a wavelength of about 520 nm**, and the PD 2025 to receive light and output a signal corresponding to the amount of received light (photoreception signal). Sakai at 28:19-26

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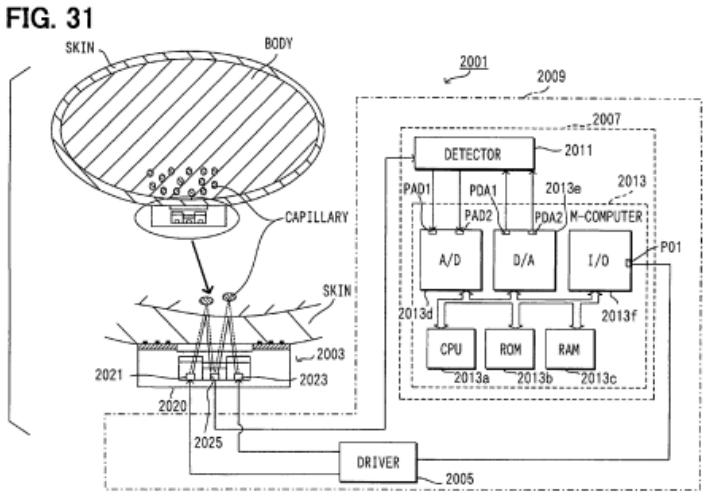
’304 Patent	Sakai
	FIG. 32A  Sakai at Fig. 32A One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Sakai discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. Next, with a voltage range where the pulse wave detection signal is detected as VR (see FIG. 17B), it is determined whether or not the percentage of unit sections, where Vg/VR is equal to or less than a lower limit value VL (in the present embodiment, 0.1) within a past preset period (in the present embodiment, 20 seconds), is equal to or higher than a predetermined percentage (in the present embodiment, 80%) (Step S1110). **When the percentage is the predetermined or higher percentage, it is determined that the amount of light in the LEDs 1011 a and 1011 b are insufficient. Then a command to increase the light emission intensity is outputted to the driver 1012 (Step S1120).** Sakai at 19:54-65

’304 Patent	Sakai
	In the steady state determination processing, **as shown in FIG. 20, first, four peak frequency components IR1 to IR4 are extracted from the highest intensity based on the result of analysis of the body motion detection signal (Step S1400). Then it is determined whether or not the intensity ratio between the peak frequency component IR1 having the highest intensity and the peak frequency component IR2 having the next highest intensity, [IR1]/[IR2], is greater than a predetermined value H2 (in the present embodiment, 10) (Step S1410). When the intensity ratio [IR1]/[IR2] is equal to or less than the predetermined value H2, it is determined whether or not the peak frequency component IR2 having the second highest intensity or the peak frequency component IR3 having the third highest intensity and the peak frequency component IR1 having the highest intensity are in relation of fundamental wave to second harmonic wave (Step S1420).** Sakai at 21:55-22:3 Further, in **the LEDs 1011 a and 1011 b to emit green light and infrared light, the amount of light can be controlled in accordance with the amplitude of pulse wave detection signal**. Sakai at 25:56-59 However, in a case where **the optical pulse wave sensor is used in the open air, sunlight noise causes a serious problem. That is, in the open air, as sunlight enters the pulse wave sensor, a pulse wave component to be detected is mixed in the sunlight noise and the pulse cannot be detected with high accuracy.** Sakai at 27:58-63. **The present embodiment has been made in view of this problem, and provides a pulse wave detection apparatus to eliminate the influence of sunlight and detect a pulse wave with high accuracy.** Sakai at 27:64-67 The direct current component is based on the changes in light amount accompanied by blood stream changes due to as follows: **expansion and contraction of blood vessel (hereinbelow, referred to as**

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	“noise A”); the change of amount of light scattered on the skin surface accompanied by shift of the pulse wave sensor 2003 (hereinbelow, referred to as “noise B”); and the change of amount of light incident from the outside of the pulse wave sensor 2003 (e.g., sunlight) etc. The direct current component is cut with the detector 2011 using a method to be described later. Sakai at 29:49-58 In the microcomputer 2013 having the above construction, **the CPU 2013 a performs processing for outputting a signal having a component corresponding to the above noise A and noise B from the above-described direct current component signal, and processing for outputting a signal having a component corresponding to external light.** Sakai at 32:41-46 First, **the processing for outputting a signal having a component corresponding to the noise A and the noise B will be described. The frequency of voltage fluctuation of photoreception signal due to the noise A and the noise B is sufficiently low in comparison with a pulse component, and the voltage fluctuation due to these noises is small in a short period. Accordingly, the CPU 2013 a analyzes the voltage fluctuation of photoreception signal within each predetermined period (e.g., 10 seconds), thereby controls output values in the D/A ports PDA1 and PDA2 in correspondence with the voltage fluctuation due to the noise A and the noise B. Thus direct current component signal corresponding to the noise A and the noise B is outputted from the corrector 2043. That is, the voltage value of the direct current component can be controlled by each time.** Sakai at 32:47-61

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	FIG. 31  Sakai at Fig. 31 In the pulse wave detection apparatus 2001 having the above construction, immediately before light emission from the green LED 2023, light received by the PD 2025 is detected as an external light reception signal (Step S2010), and the external light reception signal is outputted (Step S2020 to Step S2040). Then, light emission is performed in the green LED 2023 then in the infrared LED 2021. **Then differentiation is performed between a photoreception signal, outputted from the PD 2025 upon light emission from the green LED 2023 or the infrared LED 2021, and the external light reception signal in the amplifier 2041,** and a differentiated signal is obtained (Step S2050 to Step S2060); thereby, a pulse wave is detected. Sakai at 33:37-49 As the human body's pulse wave can be detected in consideration of light component due to external light in photoreception signal upon light emission from the infrared LED 2021 or the green LED 2023, **the influence of external light can be eliminated and the pulse wave can be detected with high accuracy**. Sakai at 33:50-55

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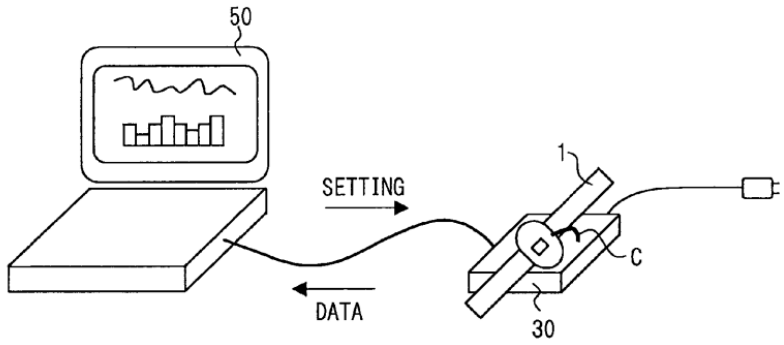
’304 Patent	Sakai
	Further, the signal from which the influence of external light is eliminated can be obtained by simple calculation of differentiation of external light reception signal from the photoreception signal. Sakai at 33:56-59 **Further, as the external light reception signal is detected when the light emission from the infrared LED 2021 and the green LED 2023 is stopped, the external light can be detected without influence of light emitted from the infrared LED 2021 or the green LED 2023.** Sakai at 33:60-64 Further, as the external light reception signal is detected immediately before light emission from the green LED 2023, **the influence of external light inputted into the PD 2025 upon light emission from the infrared LED 2021 and the green LED 2023 can be eliminated with high accuracy. At this time, light emission may be started from the green LED 2023 or the infrared LED 2021.** Sakai at 33:65-34:4 Further, the pulse wave detection apparatus 2001 of the present embodiment is used when the pulse wave sensor 2003 is fixed on the human body's skin; further, the surface of the light shielding plate 2031 in contact with the skin is coated with light absorbing color. Accordingly, when external light incident from a gap formed between the light shielding plate 2031 and the skin arrives at the light shielding plate 2031, **the external light is absorbed into the light shielding plate 2031; thus, reception of external light by the PD 2025 can be suppressed.** Sakai at 34:5-14 Further, as multiple convex members 2033 are arranged to surround the light transmitting plate 2029 on the surface of the light shielding plate 2031 on the side in contact with the skin, the convex member 2033 blocks the path of external light propagated inside the skin; thereby, the external light is scattered by the convex member 2033. Thus the reception of external light by the PD 2025 can be suppressed. **Note that**

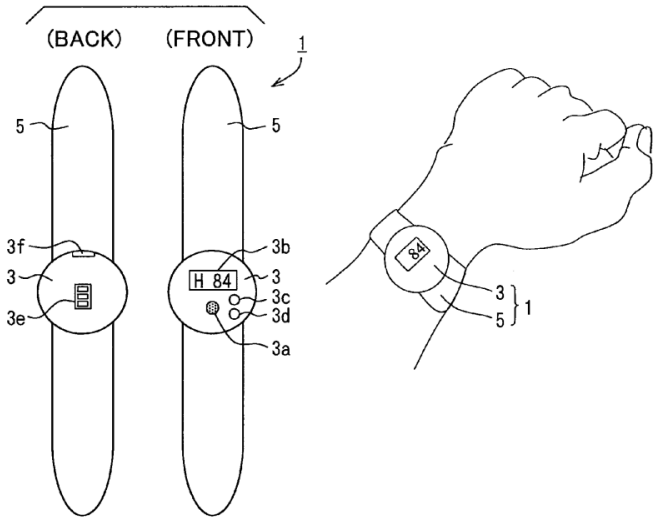
’304 Patent	Sakai
	as the number of convex members 2033 is increased, many convex members 2033 are arranged on paths of external light propagated inside the skin to the PD 2025; thereby, the reception of external light by the PD 2025 can be suppressed. Sakai at 34:15-25 Further, as the multiple convex members 2033 are arranged at random intervals, the convex members 2033 are arranged on the paths of external light propagated inside the skin, **at intervals not corresponding with an integral multiple of external light frequency. Thus the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 34:26-31 Further, as the convex members 2033 are projection lines each having head and tail ends, the air in a gap between the pulse wave sensor 2003 and the skin and the air outside the pulse wave sensor 2003 can be easily circulated via the gap 2035 formed between the points of projection line. **That is, steaming which easily occurs in a portion where the pulse wave sensor 2003 and the skin are in close contact can be suppressed.** Sakai at 34:32-39 Further, at least one convex member 2033 is provided on a line segment (e.g., a line segment B-B) connecting a gap 2035 a formed in a position most distant from the light transmitting plate 2029 and the light transmitting plate 2029. **Even if external light is incident from the gap 2035 a, the photoreception of external light by the PD 2025 can be thereby suppressed.** Sakai at 34:40-47 Further, as the material of the light shielding plate 2031 and the convex member 2033, silicon material having a flexible characteristic is used such that the light shielding plate 2031 comes to make a contact with the human body's skin without gap **when the pulse wave sensor 2003 is fixed to the human body's skin. Accordingly, a gap as a cause of incidence of external light is not formed, and the photoreception of external light by the PD 2025 can be suppressed.**

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	Sakai at 34:48-55 For example, in the above embodiment, the surface of the light shielding plate 2031 on the side in contact with the skin is coated with light absorbing color. However, a material having light absorbing characteristic (e.g., resin or rubber material) may be use as the material of the light shielding plate 2031. **In this case, when external light incident from a gap formed between the light shielding plate 2031 and the skin arrives at the light shielding plate, the external light is absorbed into the light shielding plate 2031; thus, the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 34:60-35-2 Further, the surface of the light shielding plate 2031 on the side in contact with the skin may have rough unevenness so as not to be regarded as a mirror finished surface. In this case, when external light incident from a **gap formed between the light shielding plate 2031 and the skin arrives at the light shielding plate 2031, the external light is scattered. Thus the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 35:3-10 Further, in the above embodiment, **sunlight enters as the external light; however, any other light than sunlight may be handled as external light as long as the light is incident from the outside the pulse wave sensor 2003. For example, light emitted from a fluorescent lamp may be handled as external light.** Sakai at 35:11-16 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would

’304 Patent	Sakai
	have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Sakai discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. In **a portable biological information monitor apparatus**, **a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information**. **This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] In this manner, **the portable biological information monitor apparatus according to the present invention, as a single apparatus, monitors biological information in sleep and biological information in wake. Then, a comprehensive evaluation of the test subject's status (e.g., life rhythm, activity amount (consumed calories), physical condition, and sleep quality) can be made based on sleep evaluation barometers and wake evaluation barometers generated from these pieces of biological information. Further, accurate advice can be dispensed to the test subject based on the result of evaluation.** Sakai at 2:19-28 Further, according to the present invention, **as barometers for evaluation of different actions (sleep evaluation barometers and wake evaluation barometers) are generated from the same biological information, attachment and removal of apparatuses by action is not necessary**. Further, as the apparatus itself is a portable type apparatus which does not limit the test subject's actions, **biological**

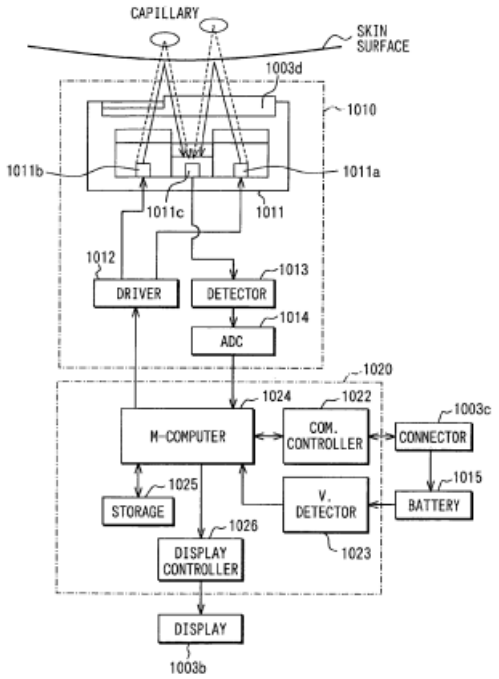
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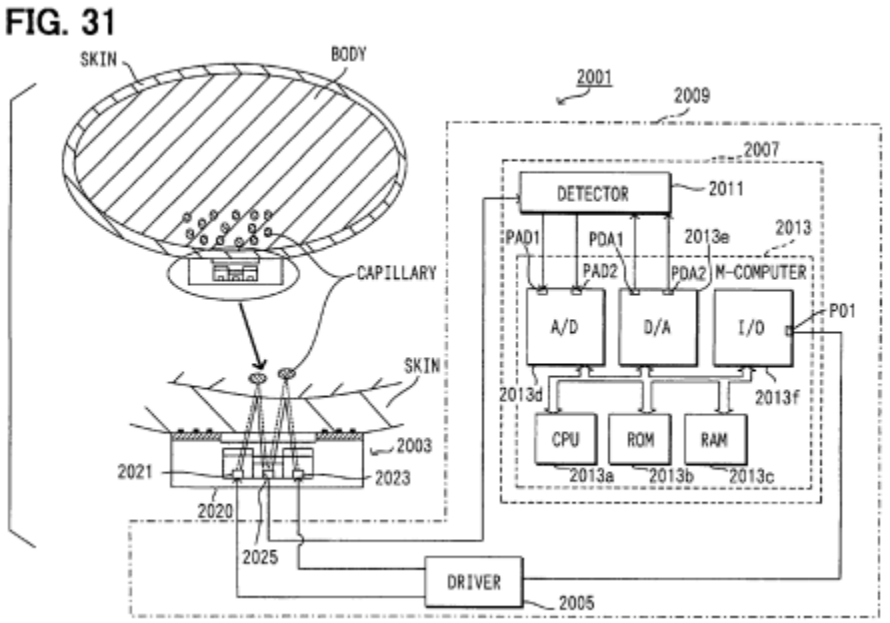
’304 Patent	Sakai
	information in normal living conditions can be easily obtained without the test subject's consciousness of measurement. Sakai at 2:29-37 As shown in FIG. 1, **the physical condition management system of the present embodiment has a portable biological information monitor apparatus 1 (hereinbelow, simply referred to as a “monitor”) which is attached to a test subject** as the subject of management when the apparatus is used; a charger 30 which charges the monitor 1 and interfaces communication with the monitor 1 via a cable C attachable to and removable from the monitor 1; and an information management unit 50 which performs communication with the monitor 1 via the charger 30 to thereby change internal settings of the monitor 1, and performs various processings based on data obtained from the monitor 1. Sakai at 4:16-27 FIG. 1  Sakai at Fig. 1. FIGS. 2A and 2B are explanatory views showing the arrangement of the monitor and the monitor apparatus in use. **As shown in FIG. 2A, the monitor 1 has a main body 3 formed to approximately**

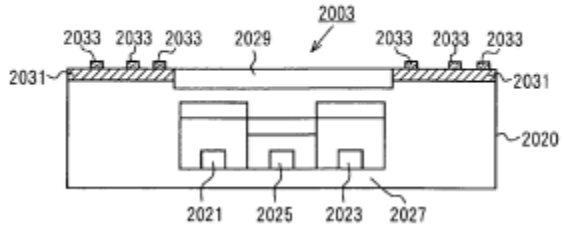
’304 Patent	Sakai
	have a size of wrist watch, and a belt-type attachment portion 5 integrally formed with the main body 3. Sakai at 4:49-53 FIG. 2A FIG. 2B  Sakai at Fig. 2A and 2B The information detection unit 10 has an optical pulse wave and **body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b;** a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20; a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. Sakai at 5:13-24

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	Note that **when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light.** Sakai at 5:25-30 Further, in the above embodiment, **the sensor having the green LED 11 a and the infrared LED 11 b is employed for biological information detection**; however, it may be arranged such that a sensor only having the green LED 11 a is used and pulse component and body motion component are extracted from a pulse wave detection signal. Sakai at 14:53-58 **The information detection unit 1010 has an optical pulse wave sensor 1011 having a green LED 1011 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 1011 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm**), and a photo diode (PD) 1011 c to receive reflected light from the LEDs 1011 a and 1011 b; a driver 1012 which drives the LEDs 1011 a and 1011 b in accordance with instructions from the information processor 1020; a detector 1013 which drives the PD 1011 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 1014 which converts the detection signal from the detector 1013 into digital data. Sakai at 17:12-24

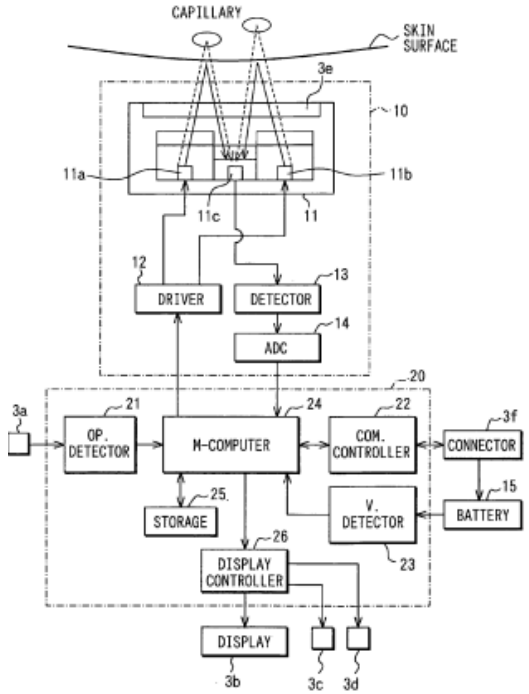
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	FIG. 13  Sakai at Fig. 13 A pulse wave detection apparatus 2001 according to the present embodiment detects a human body's pulse rate. **As shown in FIG. 31, the pulse wave detection apparatus 2001 has a pulse wave sensor 2003 including an infrared LED 2021 and a green LED 2023 as light emission devices;** a photo diode (PD) 2025 as a photoreception device; a driver 2005 which drives the pulse wave sensor 2003 by outputting driving signals to the infrared LED 2021 and the green LED 2023 to emit light at different timings; and a data processing unit 2007 which processes a signal from the pulse wave sensor 2003 and controls the driver 2005. Note that the driver 2005 and the data processing unit 2007 are accommodated in a casing of a pulse wave detection apparatus main body 2009. Sakai at 28:1-13

’304 Patent	Sakai
	The pulse wave sensor 2003 is fixed to human body's arm or the like when it is used. **As shown in FIG. 32A, the pulse wave sensor is an optical reflective type sensor having the infrared LED 2021 to emit infrared light having a wavelength of about 940 nm, the green LED 2023 to emit green light having a wavelength of about 520 nm**, and the PD 2025 to receive light and output a signal corresponding to the amount of received light (photoreception signal). Sakai at 28:19-26  Sakai at Fig. 31 In the pulse wave sensor 2003 having the above construction, first, as shown in FIG. 31, **the light transmitting plate 2029 and the light shielding plate 2031 are brought into contact with the human body's arm skin and the pulse sensor 2003 is fixed. Thereafter, the infrared LED 2021 and the green LED 2023 alternately emit infrared light and green light to the human body, and the PD 2025 receives reflected light.** Then PD 2025 outputs the change of photoreception amount as a photoreception signal (e.g., a voltage signal) to the data processing unit 2007.

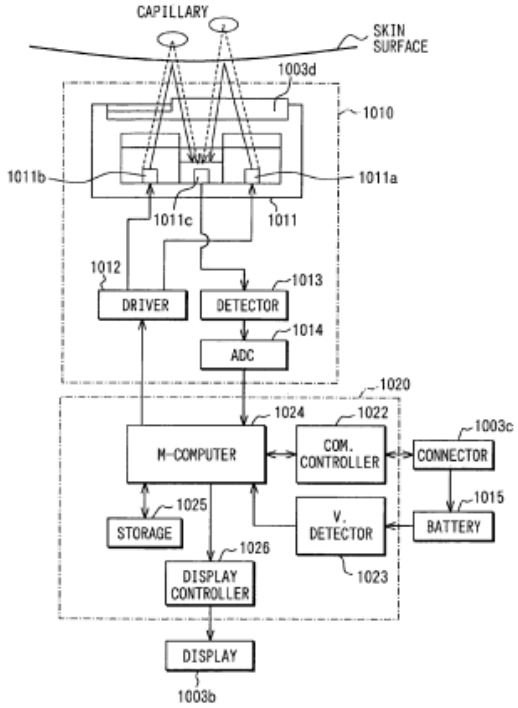
’304 Patent	Sakai
	Sakai at 29:9-18 Note **that in the light emitted from the infrared LED 2021 and the green LED 2023 to the human body, a part of the light arrives at small artery and arteriole (capillary artery) running through the human body and is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. At** this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin is also changed in an undulating manner. That is, the amount of light reflected from the capillary artery and detected by the PD 2025 changes in correspondence with the blood pulsation. Sakai at 29:19-30 FIG. 32A  Sakai at Fig. 32 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

’304 Patent	Sakai
11[d]. the wearable measurement device further comprising a receiver configured to:	Sakai discloses or renders obvious the wearable measurement device further comprising a receiver. In **the portable biological information monitor apparatus according to the present invention made to attain the above object, biological information detection means repeatedly detects a test subject's biological information reflecting pulse, body motion, and autonomic nervous system function**. Then, barometer generation means includes multiple generation modes corresponding to the test subject's actions and operates in any of generation modes based on the detected biological information. Here, the generation modes include at least a first generation mode to generate sleep evaluation barometers for evaluation of the test subject's status in sleep and a second generation mode to generate wake evaluation barometers for evaluation of the test subject's status in wake. Storage means stores the generated barometers. “Barometer” is used to mean an “indicator. Sakai at 2:4-18 FIG. 3 is a block diagram showing the construction of the monitor 1. As shown in FIG. 3, the monitor 1 has **an information detection unit 10 which emits light via the detection window 3 e and receives reflected light to thereby detect biological information;** an information processor 20 which processes the biological information detected by the information detection unit 10; and a battery 15 chargeable via the cable connected to the connector 3 f, which supplies power to the respective elements of the apparatus. Sakai at 5:3-12

’304 Patent	Sakai
	FIG. 3  Sakai at Fig. 3 **The information detection unit 10 has an optical pulse wave and body motion sensor 11** having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), and **a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b;** a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20; **a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light;** and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. Sakai at 5:13-24

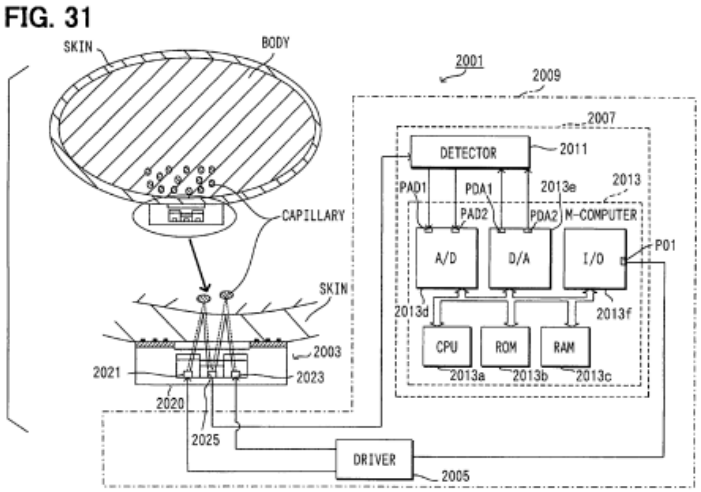
’304 Patent	Sakai
	Note that infrared light has a low light absorption characteristic in comparison with green light. As shown in FIGS. 9A and 9B, in **the detection signal obtained by the PD 11 c upon light emission from the green LED 11 a, the pulse component and body motion component are detected at extractable signal levels (see FIG. 9A). On the other hand, in the detection signal obtained by the PD 11 c upon light emission from the infrared LED 11 b, the pulse component is at a very low level in comparison with the body motion component and only the body motion component is detected at an extractable signal level** (see FIG. 9B). Note that FIGS. 9A and 9B are graphs showing frequency spectra of the detection signal. Sakai at 5:47-58 Next, FIG. 13 is a block diagram showing the construction of the biological status detection apparatus. As shown in FIG. 13, the biological status detection apparatus 1001 has **an information detection unit 1010 which emits light via the light transmitting plate 1003 b and receives reflected light thereby detects biological information**, an information processor 1020 which processes the biological information detected by the information detection unit 1010, and a battery 1015 chargeable via the cable connected to the connector 1003 c, which supplies power to the respective elements of the apparatus. Sakai at 17:1-11

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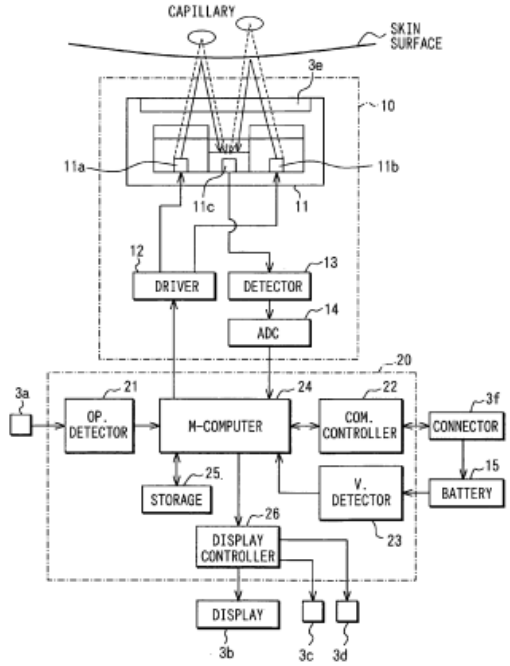
’304 Patent	Sakai
	FIG. 13  Sakai at Fig. 13 The information detection unit 1010 has an optical pulse wave sensor 1011 having a green LED 1011 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 1011 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), and **a photo diode (PD) 1011 c to receive reflected light from the LEDs 1011 a and 1011 b**; a driver 1012 which drives the LEDs 1011 a and 1011 b in accordance with instructions from the information processor 1020; a detector 1013 which drives the PD 1011 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 1014 which converts the detection signal from the detector 1013 into digital data. Sakai at 17:12-24

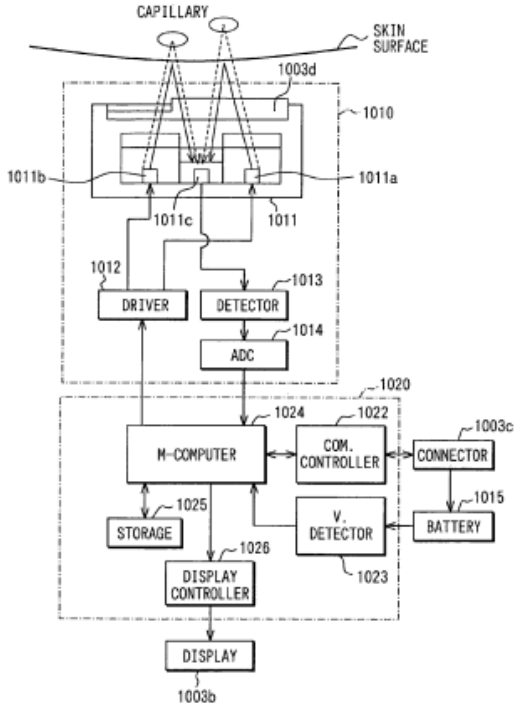
’304 Patent	Sakai
	At this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin is also changed in an undulating manner. Further, **as the amount of light (signal level of the detection signal) reflected with the capillary artery and detected by the PD 1011 c is also changed**, information on a pulse wave can be obtained from the detection signal. Sakai at 17:52-58 Note that infrared light has a low light absorption characteristic in comparison with green light. **In the detection signal detected by the PD 1011 c upon light emission from the infrared LED 1011 b (body motion detection signal),** the pulse component synchronized with the pulse is smaller in comparison with the detection signal detected by the PD 1011 c upon light emission from the green LED 1011 a (pulse wave detection signal). The body motion component synchronized with body motion is thereby relatively emphasized in the detection signal detected by the PD 1011 c upon light emission from the infrared LED 1011 b. Sakai at 18:1-11 **Upon detection of body motion detection signal (upon light emission from the infrared LED 1011 b), the detector 1013 amplifies a photoreception signal from the PD 1011 c with an amplification factor greater than that upon detection of pulse wave detection signal (upon light emission from the green LED 1011 a), such that the body motion component is further emphasized**. Sakai at 18:50-56 A pulse wave detection apparatus 2001 according to the present embodiment detects a human body's pulse rate. As shown in FIG. 31, the pulse wave detection apparatus 2001 has a pulse wave sensor 2003 including an infrared LED 2021 and a green LED 2023 as light emission devices; **a photo diode (PD) 2025 as a photoreception device;** a driver 2005 which drives the pulse wave sensor 2003 by outputting driving signals to the infrared LED 2021 and the green LED 2023 to emit light at different timings; and a data processing unit 2007 which processes a signal from the pulse wave sensor 2003 and controls the

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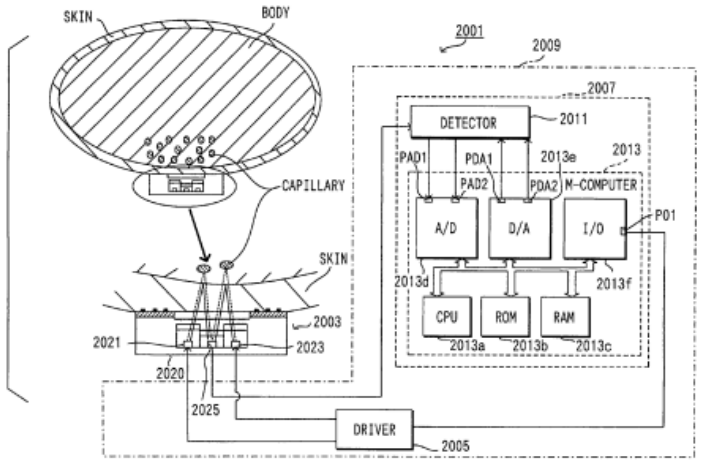
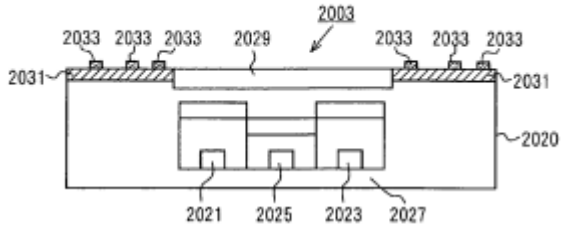
’304 Patent	Sakai
	driver 2005. Note that the driver 2005 and the data processing unit 2007 are accommodated in a casing of a pulse wave detection apparatus main body 2009. Sakai at 28:1-13  Sakai at Fig. 31 Note that in the light emitted from the infrared LED 2021 and the green LED 2023 to the human body, a part of the light arrives at small artery and arteriole (capillary artery) running through the human body and is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. At this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin is also changed in an undulating manner. **That is, the amount of light reflected from the capillary artery and detected by the PD 2025** changes in correspondence with the blood pulsation. Sakai at 29:19-30

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample,	Sakai discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. The information detection unit 10 has an optical pulse wave and body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), **and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b;** a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20; **a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light**; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. Sakai at 5:13-24

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	FIG. 3  Sakai at Fig. 3 Then a method using an optical pulse wave sensor, easily attachable to a finger or temple, in place of electrocardiograph, has been proposed. **A pulse wave is a pressure fluctuation in an artery which occurs in accordance with a heartbeat and which is transmitted to a peripheral artery as a wave. The optical pulse wave sensor measures an undulating volume change of blood in the peripheral artery by utilizing light absorption characteristic of hemoglobin in the blood.** Sakai at 15:38-45 The information detection unit 1010 has an optical pulse wave sensor 1011 having a green LED 1011 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 1011

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	b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), **and a photo diode (PD) 1011 c to receive reflected light from the LEDs 1011 a and 1011 b**; a driver 1012 which drives the LEDs 1011 a and 1011 b in accordance with instructions from the information processor 1020; **a detector 1013 which drives the PD 1011 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 1014 which converts the detection signal from the detector 1013 into digital data.** Sakai at 17:12-24 FIG. 13  Sakai at Fig. 13

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	Upon detection of body motion detection signal (upon light emission from the infrared LED 1011 b), the detector 1013 amplifies a photoreception signal from the PD 1011 c with an amplification factor greater than that upon detection of pulse wave detection signal (upon light emission from the green LED 1011 a), such that the body motion component is further emphasized. Sakai at 18:50-55 In recent years, portable type apparatuses to support periodical exercise such as a pedometer and a calorie consumption meter have been utilized for the purpose of precaution against life-style related diseases. To accurately determine the amount of exercise, it is effective to measure a pulse rate. For this purpose, an optical pulse wave sensor utilizing light absorption by blood component is frequently used. The optical pulse wave sensor, having a light emission device **and a photoreception device, emits light from the light emission device to a human body, receives reflected light with the photoreception device, and detects a pulse wave from the changes in photoreception amount.** As the optical pulse wave sensor, a well-known type of sensor is constructed such that the sensor having a light emission device and a photoreception device is fixed between the root and a second joint of human's index finger with a sensor fixing band (e.g., see WO97/037588 A1 (U.S. Pat. No. 6,241,684 B1)). Sakai at 27:41-57 A pulse wave detection apparatus 2001 according to the present embodiment detects a human body's pulse rate. As shown in FIG. 31, the pulse wave detection apparatus 2001 has a pulse wave sensor 2003 including an infrared LED 2021 and a green LED 2023 as light emission devices; **a photo diode (PD) 2025 as a photoreception device;** a driver 2005 which drives the pulse wave sensor 2003 by outputting driving signals to the infrared LED 2021 and the green LED 2023 to emit light at different timings; **and a data processing unit 2007 which processes a signal from the pulse wave sensor 2003 and controls the driver 2005.** Note that the driver 2005 and the data processing unit 2007 are accommodated in a casing of a pulse wave detection apparatus main body 2009. Sakai at 28:1-13

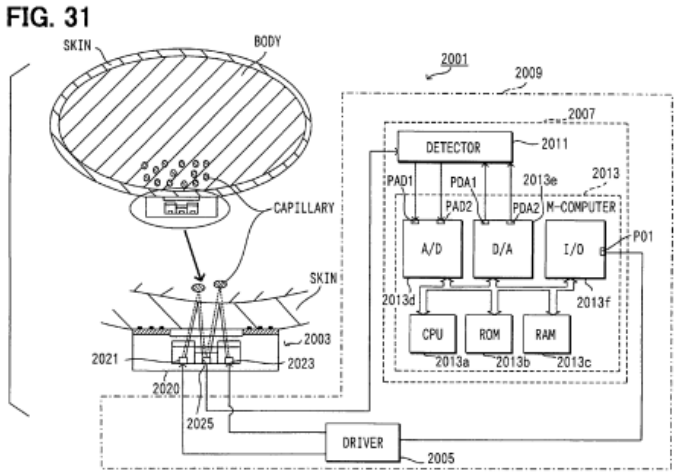
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	FIG. 31  Sakai at Fig. 31 The pulse wave sensor 2003 is fixed to human body's arm or the like when it is used. As shown in FIG. 32A, the pulse wave sensor is an optical reflective type sensor having the infrared LED 2021 to emit infrared light having a wavelength of about 940 nm, the green LED 2023 to emit green light having a wavelength of about 520 nm, **and the PD 2025 to receive light and output a signal corresponding to the amount of received light (photoreception signal).** Sakai at 28:19-26 FIG. 32A  Sakai at Fig. 32

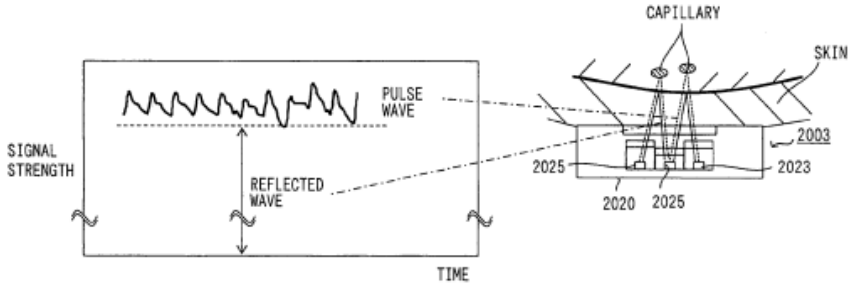
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	In the pulse wave sensor 2003 having the above construction, first, as shown in FIG. 31, the light transmitting plate 2029 and the light shielding plate 2031 are brought into contact with the human body's arm skin and the pulse sensor 2003 is fixed. **Thereafter, the infrared LED 2021 and the green LED 2023 alternately emit infrared light and green light to the human body, and the PD 2025 receives reflected light. Then PD 2025 outputs the change of photoreception amount as a photoreception signal (e.g., a voltage signal) to the data processing unit 2007.** Sakai at 29:9-18 Note that in the light emitted from the infrared LED 2021 **and the green LED 2023 to the human body, a part of the light arrives at small artery and arteriole (capillary artery) running through the human body and is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. At this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin is also changed in an undulating manner. That is, the amount of light reflected from the capillary artery and detected by the PD 2025 changes in correspondence with the blood pulsation.** Sakai at 29:19-30 The above arrangement can suppress the arrival of external light at the PD 2025**. The data processing unit 2007 has a detector 2011 to amplify the photoreception signal obtained from the pulse wave sensor 2003 and a microcomputer 2013 to process a signal from the detector 2011 and perform various computation processings such as pulse wave detection.** Sakai at 30:27-32 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Sakai disloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. Note **that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light.** Sakai at 5:25-30 Note **that as the blood stream is also influenced by body motion, the detection signal from the PD 11 c includes a body motion component synchronized with body motion as well as a pulse component synchronized with pulse (see FIG. 8). Further, all the emitted light does not arrive at the capillary artery, and light reflected from the body surface (surface reflected light) is also received with the PD 11 c. The surface reflected light also includes a body motion component.** Sakai at 5:39-46 That is, upon light emission from the green LED 11 a**, the pulse wave and body motion sensor 11 operates as a pulse wave sensor which outputs a pulse wave detection signal including pulse component and body motion component, while upon light emission from the infrared LED 11 b, operates as a body motion sensor which outputs a body motion detection signal including body motion component**. Sakai at 5:59-65 At this time, **as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin is also changed in an undulating manner. Further, as the amount of light (signal level of the detection signal) reflected with the**

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	capillary artery and detected by the PD 1011 c is also changed, information on a pulse wave can be obtained from the detection signal. Sakai at 5:31-38 Note that as **a blood stream is also influenced by body motion, the detection signal from the PD 1011 c includes a body motion component synchronized with body motion as well as a pulse component synchronized with the pulse (see FIG. 30).** Further**, all the emitted light does not arrive at the capillary artery, and light reflected from the body surface (surface reflected light) is also received with the PD 1011 c. The surface reflected light also includes a body motion component.** Sakai at 17:59-67 **When light emitted from the LEDs 1011 a and 1011 b to the test subject arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 1011 c as reflected light.** Sakai at 17:45-51 The pulse wave sensor 2003 is fixed to human body's arm or the like when it is used. As shown in FIG. 32A, the pulse wave sensor is an optical reflective type sensor having the infrared LED 2021 to emit infrared light having a wavelength of about 940 nm, the green LED 2023 to emit green light having a wavelength of about 520 nm, and **the PD 2025 to receive light and output a signal corresponding to the amount of received light (photoreception signal).** Sakai at 28:19-26 In the pulse wave sensor 2003 having the above construction, first, as shown in FIG. 31, the light transmitting plate 2029 and the light shielding plate 2031 are brought into contact with the human body's arm skin and the pulse sensor 2003 is fixed. Thereafter, the infrared LED 2021 and the green LED 2023 alternately emit infrared light and green light to the human body, and **the PD 2025 receives reflected**

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	light. Then PD 2025 outputs the change of photoreception amount as a photoreception signal (e.g., a voltage signal) to the data processing unit 2007. Sakai at 29:9-18  Sakai at Fig. 31 Accordingly, information on **a pulse wave can be obtained from the photoreception signal outputted from the PD 2025 (corresponding to the reflected light of the light emitted from the infrared LED 2021 or the green LED 2023).** Sakai at 29:31-35 Hereinbelow, the reason of use of the infrared LED 2021 and the green LED 2023 for pulse wave detection will be described. As shown in FIG. 35, **the photoreception signal outputted from the PD 2025 includes a signal indicating a pulse wave reflected from the capillary artery (pulse wave component) and a component of reflected wave from the skin surface or other portion than the capillary artery (reflected wave component). The photoreception signal is frequency-analyzed**

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	mainly to a pulse component synchronized with heartbeat, a body motion component synchronized with body motion, and approximately a direct current component (as a reflected wave component except the body motion component). Sakai at 29:36-48 FIG. 35  Sakai at Fig. 35 Regarding the pulse component and body motion component, **the light absorption characteristics of the infrared light and green light are different. In the photoreception signal outputted from the PD 2025 upon light emission from the green LED 2023, the pulse component and the body motion component are obtained at respectively extractable signal level. By contrast, in the photoreception signal outputted from the PD 2025 upon light emission from the infrared LED 2021, the pulse component is at a very low level in comparison with the body** motion component and only the body motion component is detected at an extractable signal level. Sakai at 29:59-30-2 That is, **the photoreception signal outputted from the PD 2025 upon light emission from the green LED 2023 (including the pulse component and the body motion component) is compared with the photoreception signal outputted from the PD 2025 upon light emission from the infrared LED 2021 (including only the body motion component); thereby, only the pulse component is extracted.**

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	Sakai at 30:3-10 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	Sakai discloses or renders obvious the receiver configured to synchronize to the light source. When the driver 12 is started in accordance with a command from the information processor 20, the driver 12 drives the LEDs 11 a and 11 b alternately at different timings, by preset sampling interval (50 msec in the present embodiment**). Further, the A/D converter 14 operates in synchronization with the light emission timing of the driver 12, to thereby convert the pulse wave detection signal detected upon light emission from the green LED 11 a and the body motion detection signal detected upon light emission from the infrared LED 11 b into digital data, and provides these digital data, as biological information, to the information processor 20**. Sakai at 5:66-6-9 Note that infrared light has a low light absorption characteristic in comparison with green light. In the detection signal detected by the PD 1011 c upon light emission from the infrared LED 1011 b (body motion detection signal**), the pulse component synchronized with the pulse is smaller in comparison with the detection signal detected by the PD 1011 c upon light emission from the green LED 1011 a (pulse wave detection signal). The body motion component synchronized with body motion is thereby relatively emphasized in the detection signal detected by the PD 1011 c upon light emission from the infrared LED 1011 b.** Sakai at 18:1-11

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	When the driver 1012 is started in accordance with a command from the information processor 1020, **the driver 1012 drives the LEDs 1011 a and 1011 b alternately at different timings**, by preset sampling interval (50 msec in the present embodiment). Further, **the driver 1012 controls the intensities of light emission from the LEDs 1011 a and 1011 b in accordance with commands from the information processor 1020.** Sakai at 18:35-41 **Further, the A/D converter 1014 operates in synchronization with the light emission timing of the driver 1012 to thereby convert the pulse wave detection signal detected upon light emission from the green LED 1011 a and the body motion detection signal detected upon light emission from the infrared LED 1011 b into digital data. The A/D converter 1014 then provides the digital data, as biological information, to the information processor 1020**. Sakai at 18:42-49 **Further, in the LEDs 1011 a and 1011 b to emit green light and infrared light, the amount of light can be controlled in accordance with the amplitude of pulse wave detection signal**. Sakai at 25:56-59 Hereinbelow, the reason of use of the infrared LED 2021 and the green LED 2023 for pulse wave detection will be described. As shown in FIG. 35, the photoreception signal outputted from the PD 2025 includes a signal indicating a pulse wave reflected from the capillary artery (pulse wave component) and a component of reflected wave from the skin surface or other portion than the capillary artery (reflected wave component). **The photoreception signal is frequency-analyzed mainly to a pulse component synchronized with heartbeat, a body motion component synchronized with body motion, and approximately a direct current component (as a reflected wave component except the body motion component).** Sakai at 29:36-48

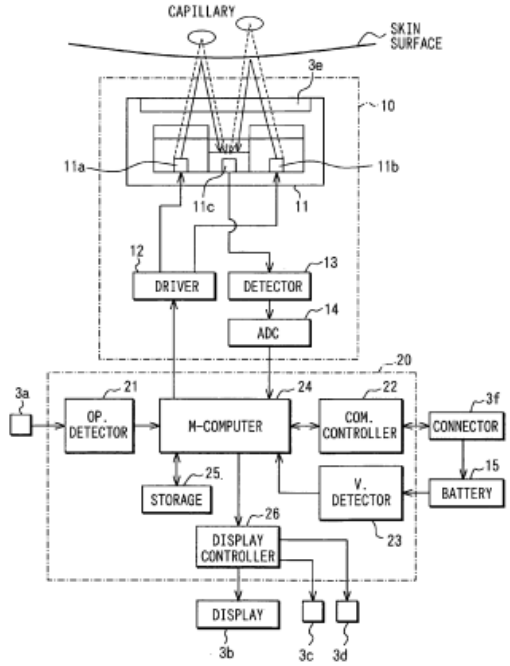
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the captured light into a first signal,	Sakai discloses or renders obvious the receiver configure to capture light while the semiconductor sources are off and convert the captured light into a first signal. When the driver 1012 is started in accordance with a command from the information processor 1020, **the driver 1012 drives the LEDs 1011 a and 1011 b alternately at different timings, by preset sampling interval (50 msec in the present embodiment).** Further, the driver 1012 controls the intensities of light emission from the LEDs 1011 a and 1011 b in accordance with commands from the information processor 1020. Sakai at 18:35-41 A pulse wave detection apparatus 2001 according to the present embodiment detects a human body's pulse rate. As shown in FIG. 31, the pulse wave detection apparatus 2001 has a pulse wave sensor 2003 including an infrared LED 2021 and a green LED 2023 as light emission devices; a photo diode (PD) 2025 as a photoreception device; **a driver 2005 which drives the pulse wave sensor 2003 by outputting driving signals to the infrared LED 2021 and the green LED 2023 to emit light at different timings**; and a data processing unit 2007 which processes a signal from the pulse wave sensor 2003 and controls the driver 2005. Note that the driver 2005 and the data processing unit 2007 are accommodated in a casing of a pulse wave detection apparatus main body 2009. Sakai at 28:1-13 Next, **external light control processing for outputting a signal having a component corresponding to the external light (hereinbelow, referred to as a “external light reception signal”) will be described with reference to FIG. 34. FIG. 34 is a flowchart showing the external light control**

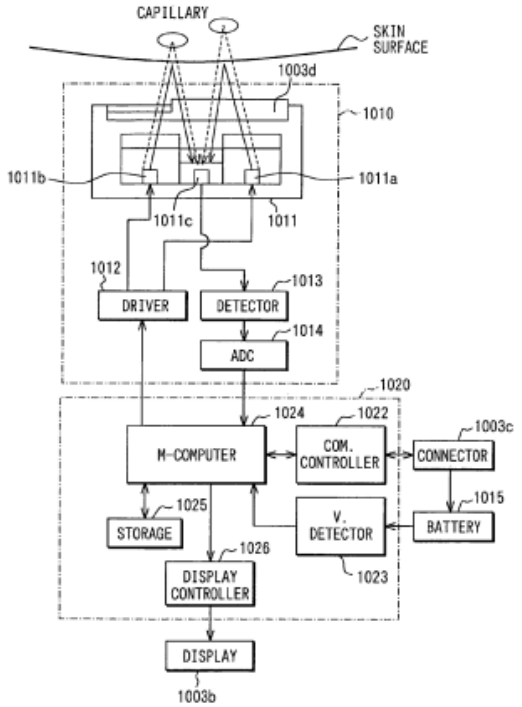
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	processing. The external light control processing is repeatedly performed upon each light emission from the infrared LED 2021 and the green LED 2023 while the CPU 2013 a is activated (power ON). Sakai at 32:62-33-3 That is, **in the external light control processing, a photoreception signal from the PD 2025 when the infrared LED 2021 and the green LED 2023 do not emit light is regarded as an external light reception signal, and voltage values of analog signals outputted from the D/A ports PDA1 and PDA2 are controlled in correspondence with the voltage value of the external light reception signal.** Sakai at 33:30-36 In **the pulse wave detection apparatus 2001 having the above construction, immediately before light emission from the green LED 2023, light received by the PD 2025 is detected as an external light reception signal (Step S2010), and the external light reception signal is outputted (Step S2020 to Step S2040).** Then, light emission is performed in the green LED 2023 then in the infrared LED 2021. Then differentiation is performed between a photoreception signal, outputted from the PD 2025 upon light emission from the green LED 2023 or the infrared LED 2021, and the external light reception signal in the amplifier 2041, and a differentiated signal is obtained (Step S2050 to Step S2060); thereby, a pulse wave is detected. Sakai at 33:37-49 Further, **as the external light reception signal is detected when the light emission from the infrared LED 2021 and the green LED 2023 is stopped, the external light can be detected without influence of light emitted from the infrared LED 2021 or the green LED 2023.** Sakai at 33:60-64 Further, as **the external light reception signal is detected immediately before light emission from the green LED 2023, the influence of external light inputted into the PD 2025 upon light emission from the infrared LED 2021 and the green LED 2023 can be eliminated with high accuracy. At this time, light emission may be started from the green LED 2023 or the infrared LED 2021.**

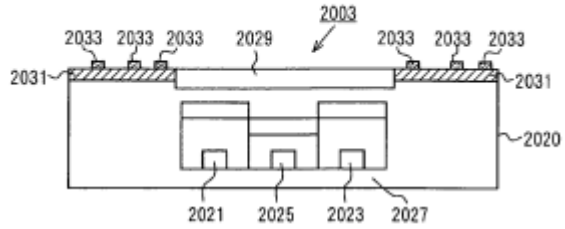
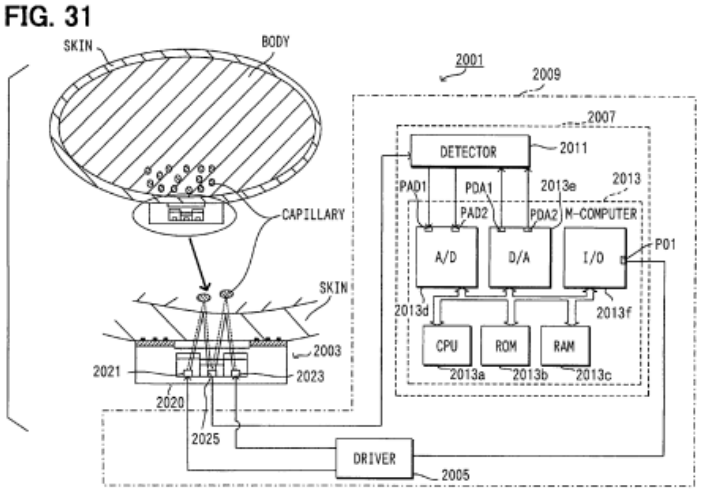
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	Sakai at 33:65-34:4 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Sakai discloses or renders obvious the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. The information detection unit 10 has an optical pulse wave and body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), **and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b;** a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20; **a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light**; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. Sakai at 5:13-24

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	FIG. 3  Sakai at Fig. 3 Then a method using an optical pulse wave sensor, easily attachable to a finger or temple, in place of electrocardiograph, has been proposed. **A pulse wave is a pressure fluctuation in an artery which occurs in accordance with a heartbeat and which is transmitted to a peripheral artery as a wave. The optical pulse wave sensor measures an undulating volume change of blood in the peripheral artery by utilizing light absorption characteristic of hemoglobin in the blood.** Sakai at 15:38-45 The information detection unit 1010 has an optical pulse wave sensor 1011 having a green LED 1011 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 1011

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	b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), **and a photo diode (PD) 1011 c to receive reflected light from the LEDs 1011 a and 1011 b**; a driver 1012 which drives the LEDs 1011 a and 1011 b in accordance with instructions from the information processor 1020; **a detector 1013 which drives the PD 1011 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 1014 which converts the detection signal from the detector 1013 into digital data.** Sakai at 17:12-24 FIG. 13  Sakai at Fig. 13

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	Upon detection of body motion detection signal (upon light emission from the infrared LED 1011 b), the detector 1013 amplifies a photoreception signal from the PD 1011 c with an amplification factor greater than that upon detection of pulse wave detection signal (upon light emission from the green LED 1011 a), such that the body motion component is further emphasized. Sakai at 18:50-56 In recent years, portable type apparatuses to support periodical exercise such as a pedometer and a calorie consumption meter have been utilized for the purpose of precaution against life-style related diseases. To accurately determine the amount of exercise, it is effective to measure a pulse rate. For this purpose, an optical pulse wave sensor utilizing light absorption by blood component is frequently used. The optical pulse wave sensor, having a light emission device **and a photoreception device, emits light from the light emission device to a human body, receives reflected light with the photoreception device, and detects a pulse wave from the changes in photoreception amount.** As the optical pulse wave sensor, a well-known type of sensor is constructed such that the sensor having a light emission device and a photoreception device is fixed between the root and a second joint of human's index finger with a sensor fixing band (e.g., see WO97/037588 A1 (U.S. Pat. No. 6,241,684 B1)). Sakai at 27:41-57 A pulse wave detection apparatus 2001 according to the present embodiment detects a human body's pulse rate. As shown in FIG. 31, the pulse wave detection apparatus 2001 has a pulse wave sensor 2003 including an infrared LED 2021 and a green LED 2023 as light emission devices; **a photo diode (PD) 2025 as a photoreception device;** a driver 2005 which drives the pulse wave sensor 2003 by outputting driving signals to the infrared LED 2021 and the green LED 2023 to emit light at different timings; **and a data processing unit 2007 which processes a signal from the pulse wave sensor 2003 and controls the driver 2005.** Note that the driver 2005 and the data processing unit 2007 are accommodated in a casing of a pulse wave detection apparatus main body 2009. Sakai at 28:1-13 The pulse wave sensor 2003 is fixed to human body's arm or the like when it is used. As shown in FIG. 32A, the pulse wave sensor is an optical reflective type sensor having the infrared LED 2021 to emit

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	infrared light having a wavelength of about 940 nm, the green LED 2023 to emit green light having a wavelength of about 520 nm, **and the PD 2025 to receive light and output a signal corresponding to the amount of received light (photoreception signal).** Sakai at 28:18-26 FIG. 32A  Sakai at Fig. 32A FIG. 31  Sakai at Fig. 31

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	In the pulse wave sensor 2003 having the above construction, first, as shown in FIG. 31, the light transmitting plate 2029 and the light shielding plate 2031 are brought into contact with the human body's arm skin and the pulse sensor 2003 is fixed. **Thereafter, the infrared LED 2021 and the green LED 2023 alternately emit infrared light and green light to the human body, and the PD 2025 receives reflected light. Then PD 2025 outputs the change of photoreception amount as a photoreception signal (e.g., a voltage signal) to the data processing unit 2007.** Sakai at 29:9-18 Note that in the light emitted from the infrared LED 2021 **and the green LED 2023 to the human body, a part of the light arrives at small artery and arteriole (capillary artery) running through the human body and is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. At this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin is also changed in an undulating manner. That is, the amount of light reflected from the capillary artery and detected by the PD 2025 changes in correspondence with the blood pulsation.** Sakai at 29:19-30 The above arrangement can suppress the arrival of external light at the PD 2025**. The data processing unit 2007 has a detector 2011 to amplify the photoreception signal obtained from the pulse wave sensor 2003 and a microcomputer 2013 to process a signal from the detector 2011 and perform various computation processings such as pulse wave detection.** Sakai at 30:27-32 At Step S2050, **light emission from the green LED 2023 is performed, and data on voltage value of signal inputted into the A/D port PAD1 is obtained. Further, at Step S2060, light emission from the infrared LED 2021 is performed, and data on voltage value of signal inputted into the A/D port PAD 1 is obtained, and the external light controlling processing ends.**

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	Sakai at 33:26-36 In the pulse wave detection apparatus 2001 having the above construction, immediately before light emission from the green LED 2023, light received by the PD 2025 is detected as an external light reception signal (Step S2010), and the external light reception signal is outputted (Step S2020 to Step S2040). **Then, light emission is performed in the green LED 2023 then in the infrared LED 2021.** Then differentiation is performed between a photoreception signal, outputted from the PD 2025 upon light emission from the green LED 2023 or the infrared LED 2021, and the external light reception signal in the amplifier 2041, and a differentiated signal is obtained (Step S2050 to Step S2060); thereby, a pulse wave is detected. Sakai at 33:37-49 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Sakai discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. At Step S2030, **the voltage fluctuation in the output from the D/A ports PDA1 and PDA2 is calculated based on a difference value between the voltage value obtained at Step S2010 and the previously obtained voltage value. Further, at Step S2040, present output values in the D/A ports PDA1 and PDA2 are controlled in correspondence with the voltage fluctuation calculated at Step S2030**. Thereafter, the process proceeds to Step S2050. Sakai at 33:16-23

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	In the pulse wave detection apparatus 2001 having the above construction, immediately before light emission from the green LED 2023, light received by the PD 2025 is detected as an external light reception signal (Step S2010), and the external light reception signal is outputted (Step S2020 to Step S2040). Then, light emission is performed in the green LED 2023 then in the infrared LED 2021. **Then differentiation is performed between a photoreception signal, outputted from the PD 2025 upon light emission from the green LED 2023 or the infrared LED 2021, and the external light reception signal in the amplifier 2041,** and a differentiated signal is obtained (Step S2050 to Step S2060); thereby, a pulse wave is detected. Sakai at 33:37-49 As the human body's pulse wave can be detected in consideration of light component due to external light in photoreception signal upon light emission from the infrared LED 2021 or the green LED 2023, **the influence of external light can be eliminated and the pulse wave can be detected with high accuracy**. Sakai at 33:50-55 **Further, the signal from which the influence of external light is eliminated can be obtained by simple calculation of differentiation of external light reception signal from the photoreception signal.** Sakai at 33:56-59 **Further, as the external light reception signal is detected when the light emission from the infrared LED 2021 and the green LED 2023 is stopped, the external light can be detected without influence of light emitted from the infrared LED 2021 or the green LED 2023.** Sakai at 33:60-64 Further, as the external light reception signal is detected immediately before light emission from the green LED 2023, **the influence of external light inputted into the PD 2025 upon light emission from**

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	the infrared LED 2021 and the green LED 2023 can be eliminated with high accuracy. At this time, light emission may be started from the green LED 2023 or the infrared LED 2021. Sakai at 33:65-34:4 Further, the pulse wave detection apparatus 2001 of the present embodiment is used when the pulse wave sensor 2003 is fixed on the human body's skin; further, the surface of the light shielding plate 2031 in contact with the skin is coated with light absorbing color. Accordingly, when external light incident from a gap formed between the light shielding plate 2031 and the skin arrives at the light shielding plate 2031, **the external light is absorbed into the light shielding plate 2031; thus, reception of external light by the PD 2025 can be suppressed.** Sakai at 34:5-14 Further, as multiple convex members 2033 are arranged to surround the light transmitting plate 2029 on the surface of the light shielding plate 2031 on the side in contact with the skin, the convex member 2033 blocks the path of external light propagated inside the skin; thereby, the external light is scattered by the convex member 2033. Thus the reception of external light by the PD 2025 can be suppressed. **Note that as the number of convex members 2033 is increased, many convex members 2033 are arranged on paths of external light propagated inside the skin to the PD 2025; thereby, the reception of external light by the PD 2025 can be suppressed.** Sakai at 34:15-25 Further, as the multiple convex members 2033 are arranged at random intervals, the convex members 2033 are arranged on the paths of external light propagated inside the skin, **at intervals not corresponding with an integral multiple of external light frequency. Thus the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 34:26-32 Further, as the convex members 2033 are projection lines each having head and tail ends, the air in a gap between the pulse wave sensor 2003 and the skin and the air outside the pulse wave sensor 2003 can be

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	easily circulated via the gap 2035 formed between the points of projection line. **That is, steaming which easily occurs in a portion where the pulse wave sensor 2003 and the skin are in close contact can be suppressed.** Sakai at 34:33-39 Further, at least one convex member 2033 is provided on a line segment (e.g., a line segment B-B) connecting a gap 2035 a formed in a position most distant from the light transmitting plate 2029 and the light transmitting plate 2029. **Even if external light is incident from the gap 2035 a, the photoreception of external light by the PD 2025 can be thereby suppressed.** Sakai at 34:40-47 Further, as the material of the light shielding plate 2031 and the convex member 2033, silicon material having a flexible characteristic is used such that the light shielding plate 2031 comes to make a contact with the human body's skin without gap **when the pulse wave sensor 2003 is fixed to the human body's skin. Accordingly, a gap as a cause of incidence of external light is not formed, and the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 34:48-55 For example, in the above embodiment, the surface of the light shielding plate 2031 on the side in contact with the skin is coated with light absorbing color. However, a material having light absorbing characteristic (e.g., resin or rubber material) may be use as the material of the light shielding plate 2031. **In this case, when external light incident from a gap formed between the light shielding plate 2031 and the skin arrives at the light shielding plate, the external light is absorbed into the light shielding plate 2031; thus, the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 34:60-35:2 Further, the surface of the light shielding plate 2031 on the side in contact with the skin may have rough unevenness so as not to be regarded as a mirror finished surface. In this case, when external light incident from a **gap formed between the light shielding plate 2031 and the skin arrives at the light shielding**

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	plate 2031, the external light is scattered. Thus the photoreception of external light by the PD 2025 can be suppressed. Sakai at 35:3-10 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	Sakai discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. Note **that the information management unit 50 includes a well-known personal computer having a keyboard, a display, a CPU, a ROM, a RAM, a hard disk, a communication interface, and the like. The communication interface is connected to a cable from the charger 30.** A management database is formed on the hard disk. The management database is generated by accumulating data obtained from the monitor 1 via the communication interface and the charger 30, with separately-inputted various data (data on the test subject which cannot be inputted with the monitor 1, data on other test subjects, and the like). **The CPU analyzes and evaluates the data accumulated in the management database, and performs processings for displaying the results of analysis and evaluation and the data accumulated in the management database on the display in various formats.** Further, a management database server may be constructed through the Internet or the like so that a third person can also manage many data. In this case, the management of data may be performed via the information management apparatus or may be directly performed with the monitor. Further, data transmission and data reception are possible. Sakai at 4:28-48

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	The information processor 20 has an operation detector 21 which detects an operation made with an operation button 3 a**; a communication controller 22 which detects cable connection with and disconnection from the connector 3 f and controls communication with an external device via the cable connected to the connector 3 f**; a voltage detector 23 which detects a voltage of the battery 15; a microcomputer 24 which performs processing for generating barometers from biological information detected by the information detection unit 10, monitoring of battery voltage via the voltage detector 23, communication processing for communication with the external device via the communication controller 22; a storage unit 25 which holds the biological information detected by the information detection unit 10 and various information generated by the microcomputer 24 based on the biological information; and a display controller 26 which displays characters and figures on the display panel 3 b and turns on and off the LEDs 3 c and 3 d in accordance with instructions from the microcomputer 24. Sakai at 6:10-28 **For example, suppose that it is arranged such that the event mode is selected as the generation mode and information (barometers) obtained by the monitor 1 are fed back to an external device** (e.g., air ventilation device, air conditioning machine or the like) having influence on the test subject's status. Here, a system can be constructed to automatically control the environment in a closed space (car interior, bedroom, meeting room, and the like) to comfortable state in accordance with the test subject's status. Sakai at 13:44-52 For example, in the above embodiment, the monitor 1 and **the information management unit 50** communicate with each other via the charger 30; however, as shown in FIG. 11, the charger may be integrated with **an information management unit 70.** Further, it may be arranged such that the charger 30 is provided with a **display unit having a screen larger than that of the monitor 1, and the monitor 1 is provided in the charger 30; thereby information obtained by the monitor 1 is displayed in more easily-viewable format in comparison with display on the display panel 3 b of the monitor 1.** Sakai at 14:31-41

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	A display panel 1003 a is provided on the front surface of the main body 1003. **A light transmitting plate 1003 b forming a detection window for transmitting light used in detection of biological information, and a connector 1003 c for connection with a cable C for communication with an external device** and for charging the apparatus are provided on the back surface of the main body 1003. Sakai at 16:43-49 **The information processor 1020 has a communication controller 1022 which detects cable connection to and disconnection from the connector 1003 c and controls communication with the external device via the cable connected to the connector 1003 c**; a voltage detector 1023 which detects a voltage of the battery 1015; a microcomputer 1024, mainly having a CPU, a ROM, and a RAM, which controls the respective elements of the apparatus and performs analysis or the like on biological information detected by the information detection unit 1010; a storage unit 1025 which holds the biological information detected by the information detection unit 1010 and various information generated by the microcomputer 1024 based on the biological information; and a display controller 1026 which displays characters and figures on the display panel 1003 a in accordance with instructions from the microcomputer 1024. Sakai at 18:57-19:5 When the power of the apparatus 1001 is turned on, the microcomputer 1024 starts the information detection unit 1010. The microcomputer 1024 performs as follows: data update processing for updating data in the buffer area ensured in the storage unit 1025 each time biological information is supplied from the information detection unit 1010; analysis processing for analyzing the data stored in the storage unit 1025; barometer generation processing for obtaining pulse rate and pulse interval as barometers for evaluation of biological status in accordance with the result of analysis in the analysis processing; display processing for displaying the barometers generated in the barometer generation processing **and charging status of the battery 1015 on the display panel 1003 b via the display controller 1026; and communication processing for performing communication with the external device via the cable connected to the connector 1003 c to transfer various data stored in the storage unit 1025, change settings of the respective elements of the apparatus 1001, and update programs executed by the microcomputer 1024, in accordance with commands inputted from the external device, and the like.**

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	Sakai at 19:12-32 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Sakai discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. 53. The information management apparatus according to claim 52, **further comprising a remote controller, for controlling operation of the portable biological information monitor apparatus via the first communication means.** Sakai at Claim 53 Note that the information management unit 50 includes a well-known personal computer having a keyboard, a display, a CPU, a ROM, a RAM, a hard disk, a communication interface, and the like. The communication interface is connected to a cable from the charger 30. A management database is formed on the hard disk. The management database is generated by accumulating data obtained from the monitor 1 via the communication interface and the charger 30, with separately-inputted various data (data on the test subject which cannot be inputted with the monitor 1, data on other test subjects, and the like). The CPU analyzes and evaluates the data accumulated in the management database, and performs processings for displaying the results of analysis and evaluation and the data accumulated in the management database on the display in various formats. **Further, a management database server may be constructed through the Internet or the like so that a third person can also manage many data. In this case, the management of data may be performed via the information management apparatus**

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	or may be directly performed with the monitor. Further, data transmission and data reception are possible. Sakai at 4:28-48 Further, when it is determined at Step S160 **that the cable C is connected to the connector 3 f, remote command processing for performing processing corresponding to a remote command inputted via the cable from the information management unit 50 is performed (Step S170),** and the process returns to Step S100. Sakai at 8:8-13 **In the remote command processing, for example, processing for transferring a part or all the information stored in the storage unit 25 to the information management unit 50, processing for updating programs executed at Step S140** (continuous monitor processing) and Step S150 (limited monitor processing), processing for changing the respective parameters and settings for generation timing, and the like can be performed. Further, it is determined via the cable C whether or not charging has been performed. When it is determined that charging has been performed, the charging check LED 3 d is turned off. Sakai at 8:14-24 Further, in the above embodiment, the communication controller 22 performs cable communication via the cable C connected to the connector 3 f; however, wireless communication may be performed. **In this case, it may be further arranged such that the operation button 3 a is omitted and a separately prepared remote controller is used, and various mode settings are performed via the communication controller 22.** Sakai at 14:45-52. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Sakai discloses or renders obvious the measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. When the normal monitor processing (calculation of wake evaluation barometers) has been completed, **it is determined based on the result of calculation (particularly the change of body motion) whether or not the test subject's action has been changed from a normal status to a status where a steady state motion such as jogging is performed, i.e., whether or not the test subject has started exercise (Step S330). When it is determined that the test subject has started exercise, the setting of the generation mode is changed to the wake steady state motion mode, and the setting of the generation timing is changed to that corresponding to the wake steady state motion mode (Step S340), and the process ends.** Sakai at 8:51-62 **When the motion monitor processing (calculation of motion evaluation barometers) has been completed, it is determined based on the result of calculation (particularly the change of body motion) whether or not the test subject's motion has been changed from the status of steady state motion to a normal status where the test subject does not do exercise, i.e., whether or not the test subject has completed the exercise (Step S390). When it is determined that the test subject has not ended the exercise, the process ends.** Sakai at 9:6-14

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	On the other hand, when it is determined that the test subject has ended the exercise, motion evaluation is performed, based on the motion evaluation barometers generated while the steady state motion mode was continued, to evaluate the load of exercise and influence of the exercise on the test subject's body (Step S400). Thereafter, the setting of the generation mode is changed to the wake normal mode, and the setting of the generation timing is changed to that corresponding to the wake normal mode (Step S410). The process then ends. Sakai at 9:15-24 **When it is determined at Step S330 that the test subject has not started exercise, it is determined based on the result of calculation in the normal monitor processing whether or not the test subject has fallen asleep (Step S350). For example, as the determination, it is determined that the test subject has fallen asleep when no body motion has occurred for a predetermined period or longer (e.g., 5 minutes) and the pulse rate has become lower than a mean value in the wake normal mode by predetermined pulse-beats (e.g., 5 beats).** Sakai at 9:25-33 **When it is determined that the test subject has not fallen asleep, the present process ends. By contrast, when it is determined that the test subject has fallen asleep, daytime activity amount evaluation is performed, based on the wake evaluation barometers and the motion evaluation barometers generated while the wake mode was continued, to comprehensively evaluate the test subject's state through the wake mode (e.g., consumed calories and activity amount).** Further, when the results of past daytime activity amount evaluation and sleep evaluation are stored in the storage unit 25, the test subject's status is comprehensively evaluated based on the past evaluation results and the result of current daytime activity amount evaluation (Step S360). Sakai at 9:34-46 **When it is determined that the test subject has not woke up, the process ends. By contrast, when it is determined that the test subject has woke up, sleep evaluation is performed based on the sleep evaluation barometers generated while the sleep mode was continued and the result of determination in the sleep abnormality determination processing, so as to evaluate the test**

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	subject's status through the entire sleep mode (e.g., the quality of sleep, the depth of sleep (rhythm), hypnagogic state, and the like). Further, when the results of past daytime activity amount evaluation and sleep evaluation are stored in the storage unit 25, the test subject's status is comprehensively evaluated based on these past evaluation results and the result of current sleep evaluation (Step S450). Sakai at 10:50-63 That is, in **the continuous monitor processing (continuous action mode), the test subject's action is estimated from the biological information (barometers), and a generation mode corresponding to the action is automatically selected while barometers appropriate to the test subject's action are generated, and evaluation and comprehensive evaluation in the generation mode are performed upon each selection of generation mode.** Sakai at 11:1-8 **Note that the sleep abnormality determination (Step S430) is performed at each detection timing; however, the determination may be performed simultaneously with the sleep evaluation (Step S450) upon changing from the sleep mode to the wake mode.** Sakai at 11:9-13 Next, **an algorithm used in calculation of barometers such as body motion, pulse, autonomic nervous function, motion pitch, and the like from biological information (sampling data of pulse detection signal and body motion detection signal) in the normal monitor processing at Step S320, the motion monitor processing at Step S380, and the sleep monitor processing at Step S420 will be described**. Sakai at 11:54-60 **The autonomic nervous function (HF, LF, and LF/HF) is obtained by using a well-known algorithm** (e.g., see JP-2002-330935 A) to repeatedly perform complex demodulation analysis on a pulse wave signal.

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	Sakai at 12:26-29 In this manner, **processing with different algorithms must be performed for the respective barometers (body motion, pulse, autonomic nervous function, and pitch). In the monitor 1, all the barometers are not always required. In the wake normal mode (normal monitor processing), body motion and pulse are obtained. In the wake steady state motion mode (motion monitor processing), body motion, pulse, and pitch are obtained. In the sleep mode (sleep monitor processing), body motion, pulse, and autonomic nervous function are obtained. Thus barometers only necessary for the set generation mode are obtained**. Sakai at 12:30-40 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Sakai discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. Further, generation timing (see Step S120) to generate barometers is determined by each generation mode. The generation timing is changed in accordance with the selected generation mode. **More particularly, as the change in pulse rate (barometer) increases during exercise, the generation time interval is shortened in the wake steady state motion mode in comparison with the wake normal mode, for detailed monitoring of heart rate change**. Further, in sleep, as the pulse rate (barometer) does not greatly change, the generation time interval in the sleep mode is longer than that in the wake mode. That is, the generation time interval is set such that [sleep mode]>[wake normal mode]>[wake motion mode] (in the present embodiment, the generation time interval in the wake normal mode is set to 1 second or longer (1 second to 5 minutes)).

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	Sakai at 7:38-52 As a result, as shown in FIG. 15A, in the pulse wave detection signal, the pulse component and the body motion component are detected at signal levels not so different from each other (in the present embodiment, about 1:5). **On the other hand, as shown in FIG. 15B, in the body motion detection signal, the pulse component is detected at a very low signal level in comparison with that of the body motion component (in the present embodiment, about 1:50).** Note that FIGS. 15A and 1 5B are graphs showing frequency spectra of pulse wave detection signal and body motion detection signal detected when body motion occurs in a test subject Sakai at 18:24-34 Then, with regard to the respective unit sections in the FFT period (past 13 seconds) used in the FFT processing on the body motion detection signal at **Step S1160, it is determined whether or not the amplitude Vir in the unit section is less than a predetermined threshold value (Step S1320). When the amplitude is equal to or greater than the threshold value in even one unit section, it is determined that body motion has occurred (Step S1360), and the process ends.** Sakai at 20:60-67 Further, **when the amplitude Vir is less than the threshold value in all the unit sections, it is determined whether or not the intensity ratio between the peak frequency components G1 and G2 of the pulse wave detection signal, [G1]/[G2] ([X] indicates the intensity of frequency component X), is greater than a predetermined value H1 (in the present embodiment, 10) (Step S1330).** When it is determined that the intensity ratio is equal to or less than the predetermined value H1, it is considered that multiple peak frequency components having considerable sufficient intensities exist and overlap with peak frequency components based on other factor than the pulse i.e. the body motion. Accordingly, it is determined that body motion has occurred (Step S1360), and the process ends. Sakai at 21:1-13 That is, **it is determined that no body motion has occurred only in a case where the amplitude of the body motion detection signal is greater than the threshold value in all the sections within the**

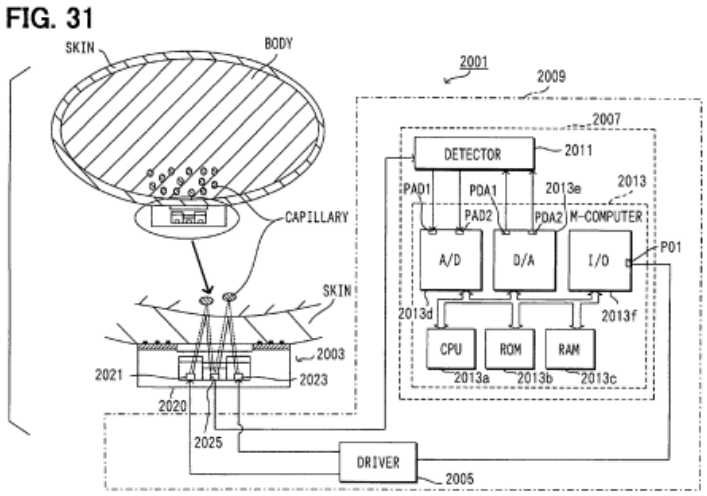
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	FFT period, and in the result of analysis of the pulse wave detection signal, the number of peak frequency components having sufficient intensities is one ([G1]/[G2]>H1) and further the intensity of the peak frequency component is higher than that of the frequency component in the body motion detection signal having the same frequency ([G1]>[IR1]). It is determined that body motion has occurred in other cases than the above case. Sakai at 21:30-40 As described above, in the biological status detection apparatus 1001 of the present embodiment, a photoreception signal from green light which is absorbed into hemoglobin by a large amount is used as a pulse wave detection signal, **and a photoreception signal from infrared light which is absorbed into hemoglobin by a small amount in comparison with that in the green light is used as a body motion detection signal.** Further, the light transmitting plate 1003 b has a shape where the degree of adhesion to the test subject's skin is high in a portion (first portion) to transmit light emitted from the green light, while the degree of adhesion to the test subject's skin is low in a portion (second portion) to transmit infrared light when the apparatus is attached to the test subject. That is, in the pulse wave detection signal, a pulse component can be detected with high sensitivity, on the other hand, in the body motion detection signal, a body motion component can be detected with high sensitivity and detection of pulse component can be suppressed. Sakai at 25:38-55 Accordingly, in the biological status detection apparatus 1001 of the present embodiment, even if t**he apparatus 1001 is attached to a portion where the sensitivity of pulse wave detection is lower in comparison with a peripheral portion such as a finger, pulse wave and body motion can be detected with high sensitivity**. Further, even if the status of attachment (the subject or position of attachment) has been changed, detection can always be performed in an appropriate status. Sakai at 25:60-26:5 Further, in the biological status detection apparatus 1001 of the present embodiment, the occurrence and nonoccurrence of body motion is determined based on, not only the amplitude of the body motion detection signal, but the result of analysis of pulse wave detection signal and body motion detection

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	signal. Here, **this analysis utilizes the fact that a harmonic wave in pulse component is very low in comparison with a fundamental wave and the fact that the ratio of pulse component detection in the pulse wave detection signal and the ratio of body motion component in the body motion detection signal are different**. Accordingly, the body motion can be detected with high accuracy. Sakai at 26:33-44 That is, **the photoreception signal outputted from the PD 2025 upon light emission from the green LED 2023 (including the pulse component and the body motion component) is compared with the photoreception signal outputted from the PD 2025 upon light emission from the infrared LED 2021 (including only the body motion component); thereby, only the pulse component is extracted**. Sakai at 30:3-9 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Sakai discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. Next, with a voltage range where the pulse wave detection signal is detected as VR (see FIG. 17B), it is determined whether or not the percentage of unit sections, where Vg/VR is equal to or less than a lower limit value VL (in the present embodiment, 0.1) within a past preset period (in the present embodiment, 20 seconds), is equal to or higher than a predetermined percentage (in the present embodiment, 80%) (Step S1110). **When the percentage is the predetermined or higher percentage, it is determined that the amount of light in the LEDs 1011 a and 1011 b are insufficient. Then a command to increase the light emission intensity is outputted to the driver 1012 (Step S1120).**

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	Sakai at 19:54-65 In the steady state determination processing, **as shown in FIG. 20, first, four peak frequency components IR1 to IR4 are extracted from the highest intensity based on the result of analysis of the body motion detection signal (Step S1400). Then it is determined whether or not the intensity ratio between the peak frequency component IR1 having the highest intensity and the peak frequency component IR2 having the next highest intensity, [IR1]/[IR2], is greater than a predetermined value H2 (in the present embodiment, 10) (Step S1410). When the intensity ratio [IR1]/[IR2] is equal to or less than the predetermined value H2, it is determined whether or not the peak frequency component IR2 having the second highest intensity or the peak frequency component IR3 having the third highest intensity and the peak frequency component IR1 having the highest intensity are in relation of fundamental wave to second harmonic wave (Step S1420).** Sakai at 21:55-22:3 Further, in **the LEDs 1011 a and 1011 b to emit green light and infrared light, the amount of light can be controlled in accordance with the amplitude of pulse wave detection signal**. Sakai at 25:56-59 However, in a case where **the optical pulse wave sensor is used in the open air, sunlight noise causes a serious problem. That is, in the open air, as sunlight enters the pulse wave sensor, a pulse wave component to be detected is mixed in the sunlight noise and the pulse cannot be detected with high accuracy.** Sakai at 27:58-63 **The present embodiment has been made in view of this problem, and provides a pulse wave detection apparatus to eliminate the influence of sunlight and detect a pulse wave with high accuracy.** Sakai at 27:64-67

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	The direct current component is based on the changes in light amount accompanied by blood stream changes due to as follows: **expansion and contraction of blood vessel (hereinbelow, referred to as “noise A”); the change of amount of light scattered on the skin surface accompanied by shift of the pulse wave sensor 2003 (hereinbelow, referred to as “noise B”); and the change of amount of light incident from the outside of the pulse wave sensor 2003 (e.g., sunlight) etc. The direct current component is cut with the detector 2011 using a method to be described later.** Sakai at 29:49-58 In the microcomputer 2013 having the above construction, **the CPU 2013 a performs processing for outputting a signal having a component corresponding to the above noise A and noise B from the above-described direct current component signal, and processing for outputting a signal having a component corresponding to external light.** Sakai at 32:41-46 First, **the processing for outputting a signal having a component corresponding to the noise A and the noise B will be described. The frequency of voltage fluctuation of photoreception signal due to the noise A and the noise B is sufficiently low in comparison with a pulse component, and the voltage fluctuation due to these noises is small in a short period. Accordingly, the CPU 2013 a analyzes the voltage fluctuation of photoreception signal within each predetermined period (e.g., 10 seconds), thereby controls output values in the D/A ports PDA1 and PDA2 in correspondence with the voltage fluctuation due to the noise A and the noise B. Thus direct current component signal corresponding to the noise A and the noise B is outputted from the corrector 2043. That is, the voltage value of the direct current component can be controlled by each time.** Sakai at 32:47-61

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	FIG. 31  Sakai at Fig. 31 In the pulse wave detection apparatus 2001 having the above construction, immediately before light emission from the green LED 2023, light received by the PD 2025 is detected as an external light reception signal (Step S2010), and the external light reception signal is outputted (Step S2020 to Step S2040). Then, light emission is performed in the green LED 2023 then in the infrared LED 2021. **Then differentiation is performed between a photoreception signal, outputted from the PD 2025 upon light emission from the green LED 2023 or the infrared LED 2021, and the external light reception signal in the amplifier 2041,** and a differentiated signal is obtained (Step S2050 to Step S2060); thereby, a pulse wave is detected. Sakai at 33:37-49 As the human body's pulse wave can be detected in consideration of light component due to external light in photoreception signal upon light emission from the infrared LED 2021 or the green LED 2023, **the influence of external light can be eliminated and the pulse wave can be detected with high accuracy**. Sakai at 33:50-55

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	Further, the signal from which the influence of external light is eliminated can be obtained by simple calculation of differentiation of external light reception signal from the photoreception signal. Sakai at 33:56-59 **Further, as the external light reception signal is detected when the light emission from the infrared LED 2021 and the green LED 2023 is stopped, the external light can be detected without influence of light emitted from the infrared LED 2021 or the green LED 2023.** Sakai at 33:60-64 Further, as the external light reception signal is detected immediately before light emission from the green LED 2023, **the influence of external light inputted into the PD 2025 upon light emission from the infrared LED 2021 and the green LED 2023 can be eliminated with high accuracy. At this time, light emission may be started from the green LED 2023 or the infrared LED 2021.** Sakai at 33:65-34:4 Further, the pulse wave detection apparatus 2001 of the present embodiment is used when the pulse wave sensor 2003 is fixed on the human body's skin; further, the surface of the light shielding plate 2031 in contact with the skin is coated with light absorbing color. Accordingly, when external light incident from a gap formed between the light shielding plate 2031 and the skin arrives at the light shielding plate 2031, **the external light is absorbed into the light shielding plate 2031; thus, reception of external light by the PD 2025 can be suppressed.** Sakai at 34:5-14 Further, as multiple convex members 2033 are arranged to surround the light transmitting plate 2029 on the surface of the light shielding plate 2031 on the side in contact with the skin, the convex member 2033 blocks the path of external light propagated inside the skin; thereby, the external light is scattered by the convex member 2033. Thus the reception of external light by the PD 2025 can be suppressed. **Note that**

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	as the number of convex members 2033 is increased, many convex members 2033 are arranged on paths of external light propagated inside the skin to the PD 2025; thereby, the reception of external light by the PD 2025 can be suppressed. Sakai at 34:15-25 Further, as the multiple convex members 2033 are arranged at random intervals, the convex members 2033 are arranged on the paths of external light propagated inside the skin, **at intervals not corresponding with an integral multiple of external light frequency. Thus the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 34:26-31 Further, as the convex members 2033 are projection lines each having head and tail ends, the air in a gap between the pulse wave sensor 2003 and the skin and the air outside the pulse wave sensor 2003 can be easily circulated via the gap 2035 formed between the points of projection line. **That is, steaming which easily occurs in a portion where the pulse wave sensor 2003 and the skin are in close contact can be suppressed.** Sakai at 34:32-39 Further, at least one convex member 2033 is provided on a line segment (e.g., a line segment B-B) connecting a gap 2035 a formed in a position most distant from the light transmitting plate 2029 and the light transmitting plate 2029. **Even if external light is incident from the gap 2035 a, the photoreception of external light by the PD 2025 can be thereby suppressed.** Sakai at 34:40-47 Further, as the material of the light shielding plate 2031 and the convex member 2033, silicon material having a flexible characteristic is used such that the light shielding plate 2031 comes to make a contact with the human body's skin without gap **when the pulse wave sensor 2003 is fixed to the human body's skin. Accordingly, a gap as a cause of incidence of external light is not formed, and the photoreception of external light by the PD 2025 can be suppressed.**

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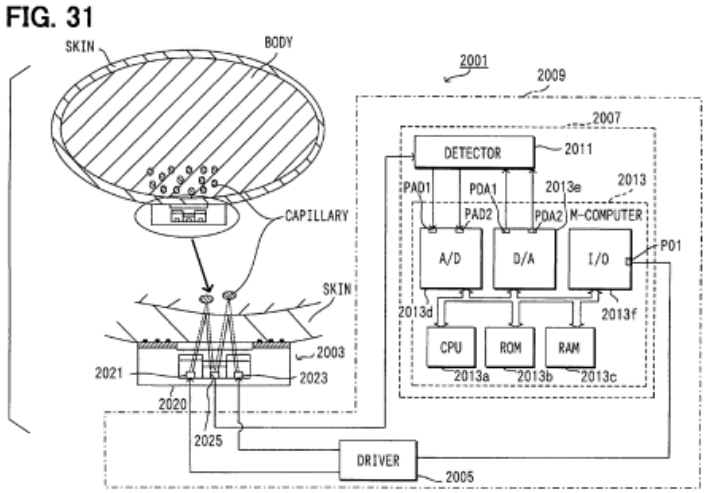
'304 Patent	Sakai
	Sakai at 34:48-55 For example, in the above embodiment, the surface of the light shielding plate 2031 on the side in contact with the skin is coated with light absorbing color. However, a material having light absorbing characteristic (e.g., resin or rubber material) may be use as the material of the light shielding plate 2031. **In this case, when external light incident from a gap formed between the light shielding plate 2031 and the skin arrives at the light shielding plate, the external light is absorbed into the light shielding plate 2031; thus, the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 34:60-35-2 Further, the surface of the light shielding plate 2031 on the side in contact with the skin may have rough unevenness so as not to be regarded as a mirror finished surface. In this case, when external light incident from a **gap formed between the light shielding plate 2031 and the skin arrives at the light shielding plate 2031, the external light is scattered. Thus the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 35:3-10 Further, in the above embodiment, **sunlight enters as the external light; however, any other light than sunlight may be handled as external light as long as the light is incident from the outside the pulse wave sensor 2003. For example, light emitted from a fluorescent lamp may be handled as external light.** Sakai at 35:11-16 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Sakai discloses or renders obvious the measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. Next, with a voltage range where the pulse wave detection signal is detected as VR (see FIG. 17B), it is determined whether or not the percentage of unit sections, where Vg/VR is equal to or less than a lower limit value VL (in the present embodiment, 0.1) within a past preset period (in the present embodiment, 20 seconds), is equal to or higher than a predetermined percentage (in the present embodiment, 80%) (Step S1110). **When the percentage is the predetermined or higher percentage, it is determined that the amount of light in the LEDs 1011 a and 1011 b are insufficient. Then a command to increase the light emission intensity is outputted to the driver 1012 (Step S1120).** Sakai at 19:54-65 In the steady state determination processing, **as shown in FIG. 20, first, four peak frequency components IR1 to IR4 are extracted from the highest intensity based on the result of analysis of the body motion detection signal (Step S1400). Then it is determined whether or not the intensity ratio between the peak frequency component IR1 having the highest intensity and the peak frequency component IR2 having the next highest intensity, [IR1]/[IR2], is greater than a predetermined value H2 (in the present embodiment, 10) (Step S1410). When the intensity ratio [IR1]/[IR2] is equal to or less than the predetermined value H2, it is determined whether or not the peak frequency component IR2 having the second highest intensity or the peak frequency component IR3 having the third highest intensity and the peak frequency component IR1 having the highest intensity are in relation of fundamental wave to second harmonic wave (Step S1420).** Sakai at 21:55-22:3

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	Further, in **the LEDs 1011 a and 1011 b to emit green light and infrared light, the amount of light can be controlled in accordance with the amplitude of pulse wave detection signal**. Sakai at 25:56-59 However, in a case where **the optical pulse wave sensor is used in the open air, sunlight noise causes a serious problem. That is, in the open air, as sunlight enters the pulse wave sensor, a pulse wave component to be detected is mixed in the sunlight noise and the pulse cannot be detected with high accuracy.** Sakai at 27:58-63 **The present embodiment has been made in view of this problem, and provides a pulse wave detection apparatus to eliminate the influence of sunlight and detect a pulse wave with high accuracy.** Sakai at 27:64-67 The direct current component is based on the changes in light amount accompanied by blood stream changes due to as follows: **expansion and contraction of blood vessel (hereinbelow, referred to as “noise A”); the change of amount of light scattered on the skin surface accompanied by shift of the pulse wave sensor 2003 (hereinbelow, referred to as “noise B”); and the change of amount of light incident from the outside of the pulse wave sensor 2003 (e.g., sunlight) etc. The direct current component is cut with the detector 2011 using a method to be described later.** Sakai at 29:49-58 In the microcomputer 2013 having the above construction, **the CPU 2013 a performs processing for outputting a signal having a component corresponding to the above noise A and noise B from the above-described direct current component signal, and processing for outputting a signal having a component corresponding to external light.** Sakai at 32:41-46

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	First, **the processing for outputting a signal having a component corresponding to the noise A and the noise B will be described. The frequency of voltage fluctuation of photoreception signal due to the noise A and the noise B is sufficiently low in comparison with a pulse component, and the voltage fluctuation due to these noises is small in a short period. Accordingly, the CPU 2013 a analyzes the voltage fluctuation of photoreception signal within each predetermined period (e.g., 10 seconds), thereby controls output values in the D/A ports PDA1 and PDA2 in correspondence with the voltage fluctuation due to the noise A and the noise B. Thus direct current component signal corresponding to the noise A and the noise B is outputted from the corrector 2043. That is, the voltage value of the direct current component can be controlled by each time.** Sakai at 32:47-61  Sakai at Fig. 31 In the pulse wave detection apparatus 2001 having the above construction, immediately before light emission from the green LED 2023, light received by the PD 2025 is detected as an external light reception signal (Step S2010), and the external light reception signal is outputted (Step S2020 to Step S2040). Then, light emission is performed in the green LED 2023 then in the infrared LED 2021. **Then**

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	differentiation is performed between a photoreception signal, outputted from the PD 2025 upon light emission from the green LED 2023 or the infrared LED 2021, and the external light reception signal in the amplifier 2041, and a differentiated signal is obtained (Step S2050 to Step S2060); thereby, a pulse wave is detected. Sakai at 33:37-49 As the human body's pulse wave can be detected in consideration of light component due to external light in photoreception signal upon light emission from the infrared LED 2021 or the green LED 2023, **the influence of external light can be eliminated and the pulse wave can be detected with high accuracy**. Sakai at 33:50-55 **Further, the signal from which the influence of external light is eliminated can be obtained by simple calculation of differentiation of external light reception signal from the photoreception signal.** Sakai at 33:56-59 **Further, as the external light reception signal is detected when the light emission from the infrared LED 2021 and the green LED 2023 is stopped, the external light can be detected without influence of light emitted from the infrared LED 2021 or the green LED 2023.** Sakai at 33:60-64 Further, as the external light reception signal is detected immediately before light emission from the green LED 2023, **the influence of external light inputted into the PD 2025 upon light emission from the infrared LED 2021 and the green LED 2023 can be eliminated with high accuracy. At this time, light emission may be started from the green LED 2023 or the infrared LED 2021.** Sakai at 33:65-34:4

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	Further, the pulse wave detection apparatus 2001 of the present embodiment is used when the pulse wave sensor 2003 is fixed on the human body's skin; further, the surface of the light shielding plate 2031 in contact with the skin is coated with light absorbing color. Accordingly, when external light incident from a gap formed between the light shielding plate 2031 and the skin arrives at the light shielding plate 2031, **the external light is absorbed into the light shielding plate 2031; thus, reception of external light by the PD 2025 can be suppressed.** Sakai at 34:5-14 Further, as multiple convex members 2033 are arranged to surround the light transmitting plate 2029 on the surface of the light shielding plate 2031 on the side in contact with the skin, the convex member 2033 blocks the path of external light propagated inside the skin; thereby, the external light is scattered by the convex member 2033. Thus the reception of external light by the PD 2025 can be suppressed. **Note that as the number of convex members 2033 is increased, many convex members 2033 are arranged on paths of external light propagated inside the skin to the PD 2025; thereby, the reception of external light by the PD 2025 can be suppressed.** Sakai at 34:15-25 Further, as the multiple convex members 2033 are arranged at random intervals, the convex members 2033 are arranged on the paths of external light propagated inside the skin, **at intervals not corresponding with an integral multiple of external light frequency. Thus the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 34:26-31 Further, as the convex members 2033 are projection lines each having head and tail ends, the air in a gap between the pulse wave sensor 2003 and the skin and the air outside the pulse wave sensor 2003 can be easily circulated via the gap 2035 formed between the points of projection line. **That is, steaming which easily occurs in a portion where the pulse wave sensor 2003 and the skin are in close contact can be suppressed.** Sakai at 34:32-39

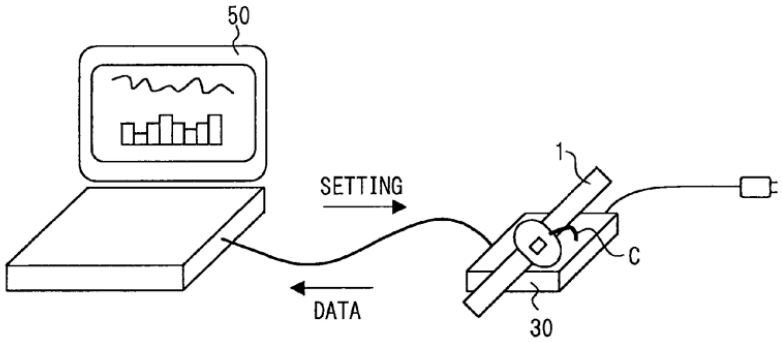
’304 Patent	Sakai
	Further, at least one convex member 2033 is provided on a line segment (e.g., a line segment B-B) connecting a gap 2035 a formed in a position most distant from the light transmitting plate 2029 and the light transmitting plate 2029. **Even if external light is incident from the gap 2035 a, the photoreception of external light by the PD 2025 can be thereby suppressed.** Sakai at 34:40-47 Further, as the material of the light shielding plate 2031 and the convex member 2033, silicon material having a flexible characteristic is used such that the light shielding plate 2031 comes to make a contact with the human body's skin without gap **when the pulse wave sensor 2003 is fixed to the human body's skin. Accordingly, a gap as a cause of incidence of external light is not formed, and the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 34:48-55 For example, in the above embodiment, the surface of the light shielding plate 2031 on the side in contact with the skin is coated with light absorbing color. However, a material having light absorbing characteristic (e.g., resin or rubber material) may be use as the material of the light shielding plate 2031. **In this case, when external light incident from a gap formed between the light shielding plate 2031 and the skin arrives at the light shielding plate, the external light is absorbed into the light shielding plate 2031; thus, the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 34:60-35-2 Further, the surface of the light shielding plate 2031 on the side in contact with the skin may have rough unevenness so as not to be regarded as a mirror finished surface. In this case, when external light incident from a **gap formed between the light shielding plate 2031 and the skin arrives at the light shielding plate 2031, the external light is scattered. Thus the photoreception of external light by the PD 2025 can be suppressed.** Sakai at 35:3-10

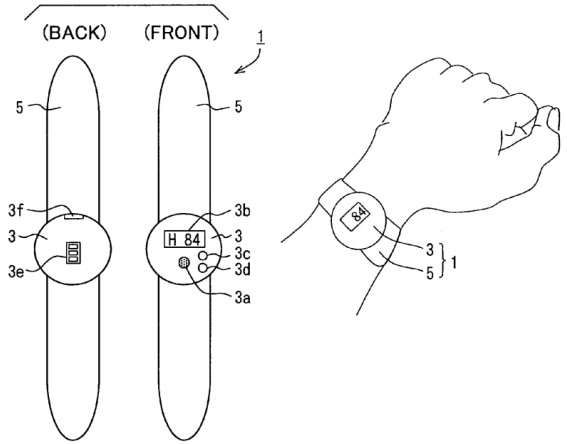
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	Further, in the above embodiment, **sunlight enters as the external light; however, any other light than sunlight may be handled as external light as long as the light is incident from the outside the pulse wave sensor 2003. For example, light emitted from a fluorescent lamp may be handled as external light.** Sakai at 35:11-16 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Sakai discloses or renders obvious the measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above. In **a portable biological information monitor apparatus**, **a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information**. **This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. Necessary barometers are**

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	thereby generated regardless of the test subject's action using the portable monitor apparatus alone. Sakai at [Abstract] In this manner, **the portable biological information monitor apparatus according to the present invention, as a single apparatus, monitors biological information in sleep and biological information in wake. Then, a comprehensive evaluation of the test subject's status (e.g., life rhythm, activity amount (consumed calories), physical condition, and sleep quality) can be made based on sleep evaluation barometers and wake evaluation barometers generated from these pieces of biological information. Further, accurate advice can be dispensed to the test subject based on the result of evaluation.** Sakai at 2:19-28 Further, according to the present invention, **as barometers for evaluation of different actions (sleep evaluation barometers and wake evaluation barometers) are generated from the same biological information, attachment and removal of apparatuses by action is not necessary**. Further, as the apparatus itself is a portable type apparatus which does not limit the test subject's actions, **biological information in normal living conditions can be easily obtained without the test subject's consciousness of measurement.** Sakai at 2:29-37 As shown in FIG. 1, **the physical condition management system of the present embodiment has a portable biological information monitor apparatus 1 (hereinbelow, simply referred to as a “monitor”) which is attached to a test subject** as the subject of management when the apparatus is used; a charger 30 which charges the monitor 1 and interfaces communication with the monitor 1 via a cable C attachable to and removable from the monitor 1; and an information management unit 50 which performs communication with the monitor 1 via the charger 30 to thereby change internal settings of the monitor 1, and performs various processings based on data obtained from the monitor 1. Sakai at 4:16-27

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	FIG. 1  Sakai at Fig. 1 FIGS. 2A and 2B are explanatory views showing the arrangement of the monitor and the monitor apparatus in use. **As shown in FIG. 2A, the monitor 1 has a main body 3 formed to approximately have a size of wrist watch, and a belt-type attachment portion 5 integrally formed with the main body 3.** Sakai at 4:49-53

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	FIG. 2A FIG. 2B  Sakai at Fig. 2A and 2B The information detection unit 10 has an optical pulse wave and **body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b;** a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20; a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. Sakai at 5:13-24 FIG. 3 is a block diagram showing the construction of the monitor 1. As shown in FIG. 3, the monitor 1 has an information detection unit 10 which emits light via the detection window 3 e **and receives reflected light to thereby detect biological information;** an information processor 20 which processes the biological information detected by the information detection unit 10; and a battery 15 chargeable via the cable connected to the connector 3 f, which supplies power to the respective elements of the apparatus.

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	Sakai at 5:4-12 Note that **when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body,** a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:25-30 At this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin also changes in an undulating manner**. Further, as the amount of received light (signal level of the detection signal) reflected with the capillary artery and detected by the PD 11 c also changes, i**nformation on pulse wave can be obtained from the detection signal Sakai at 5:31-38 Note that as the blood stream is also influenced by body motion, the detection signal from the PD 11 c includes a body motion component synchronized with body motion as well as a pulse component synchronized with pulse (see FIG. 8). Further, **all the emitted light does not arrive at the capillary artery, and light reflected from the body surface (surface reflected light) is also received with the PD 11 c. The surface reflected light also includes a body motion component.** Sakai at 5:39-46 Further, in the above embodiment, **the sensor having the green LED 11 a and the infrared LED 11 b is employed for biological information detection**; however, it may be arranged such that a sensor only having the green LED 11 a is used and pulse component and body motion component are extracted from a pulse wave detection signal. Sakai at 14:53-58

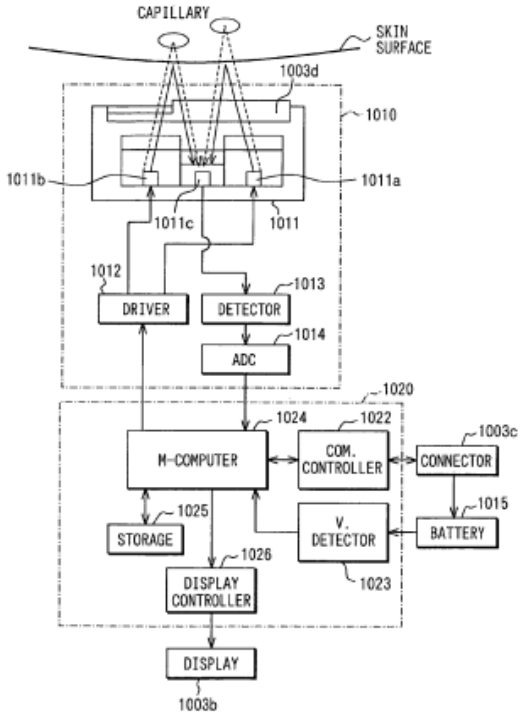
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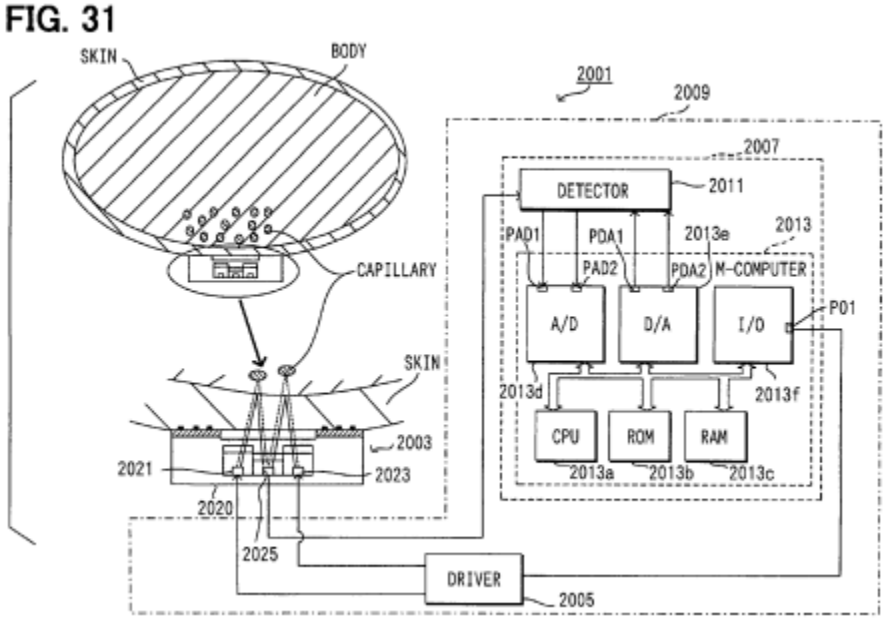
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	Further, an apparatus using an optical pulse wave sensor to emit two types of lights having different wavelengths is known (e.g., see JP-H7-88092 A (U.S. Pat. No. 6,022,321)). The apparatus discriminates a pulse component from a body motion component and detects exercise intensity of the living body or the like, from a ratio and the change of rate between amplitudes of peak frequency components included in the respective detection signals. **The detection signals are detected using the lights having different wavelengths.** Here, two facts are utilized, i.e, the first fact that the light absorption characteristic of blood component changes in correspondence with light wavelength, and the second fact that the motion of living body influences blood flow rate. Sakai at 16:3-15 **The information detection unit 1010 has an optical pulse wave sensor 1011 having a green LED 1011 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 1011 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm**), **and a photo diode (PD) 1011 c to receive reflected light from the LEDs 1011 a and 1011 b;** a driver 1012 which drives the LEDs 1011 a and 1011 b in accordance with instructions from the information processor 1020; a detector 1013 which drives the PD 1011 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 1014 which converts the detection signal from the detector 1013 into digital data.\ Sakai at 17:12-24 Further, in the light transmitting plate 1003 b, a portion opposite to the green LED 1011 a and the photo diode 1011 c (hereinbelow, referred to as a “first portion”), i.e., **a portion as a path of light emitted from the green LED 1011 a and its reflected light**, is projected further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm). By contrast, a portion opposite to the infrared LED 1011 b (hereinbelow, referred to as a “second portion”), i.e., a portion as a path of light emitted from the infrared LED 1011 b, has a shape dented further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm). Suppose the degree of adhesion to the test subject's skin when the apparatus 1001 is attached to the test subject, as shown in FIG. 14. Here, t**he degree of adhesion to the test subject's skin is high in the portion as a path of light emitted from the green LED 1011 a (green light) and its reflected light.** By contrast, the degree

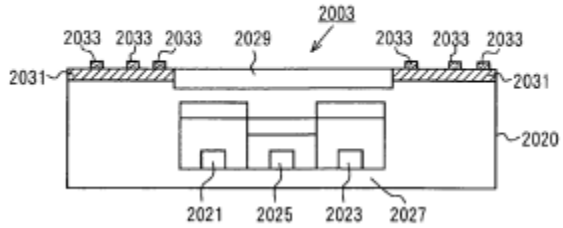
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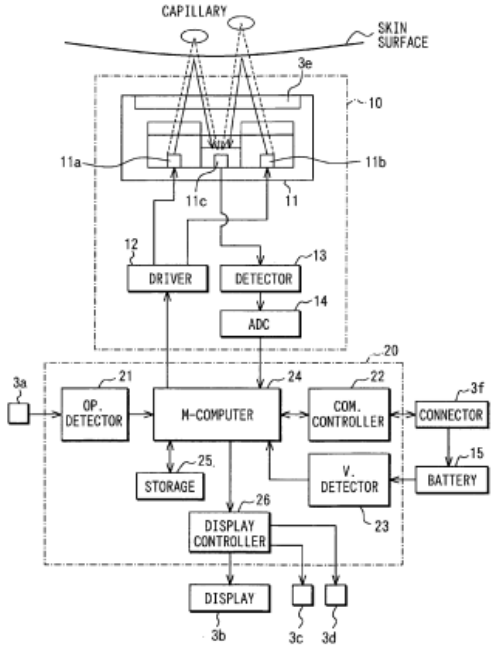
’304 Patent	Sakai
	of adhesion to the test subject's skin is low (or the portion is not in close contact with the skin) in the portion as a path of light emitted from the infrared LED 1011 b (infrared light). Sakai at 17:25-44 **When light emitted from the LEDs 1011 a and 1011 b to the test subject arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 1011 c as reflected light.** Sakai at 17:45-51 Note that as a blood stream is also influenced by body motion, the detection signal from the PD 1011 c includes a body motion component synchronized with body motion as well as a pulse component synchronized with the pulse (see FIG. 30). **Further, all the emitted light does not arrive at the capillary artery, and light reflected from the body surface (surface reflected light) is also received with the PD 1011 c. The surface reflected light also includes a body motion component.** Sakai at 17:59-67

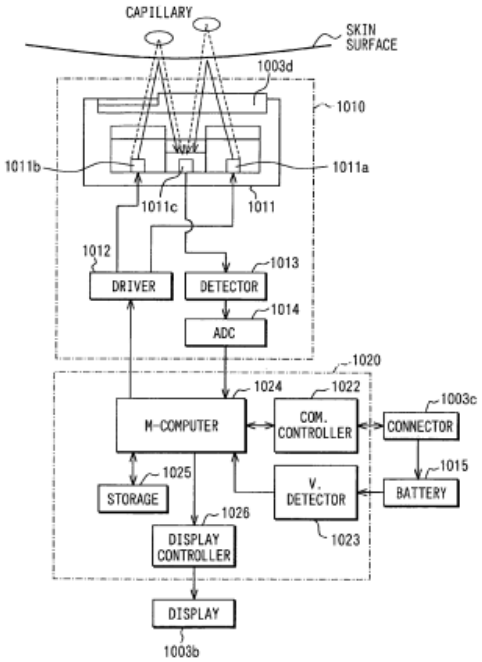
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’304 Patent	Sakai
	FIG. 13  Sakai at Fig. 13. A pulse wave detection apparatus 2001 according to the present embodiment detects a human body's pulse rate. **As shown in FIG. 31, the pulse wave detection apparatus 2001 has a pulse wave sensor 2003 including an infrared LED 2021 and a green LED 2023 as light emission devices;** a photo diode (PD) 2025 as a photoreception device; a driver 2005 which drives the pulse wave sensor 2003 by outputting driving signals to the infrared LED 2021 and the green LED 2023 to emit light at different timings; and a data processing unit 2007 which processes a signal from the pulse wave sensor 2003 and controls the driver 2005. Note that the driver 2005 and the data processing unit 2007 are accommodated in a casing of a pulse wave detection apparatus main body 2009.

’304 Patent	Sakai
	Sakai at 28:1-13  Sakai at Fig. 31 The pulse wave sensor 2003 is fixed to human body's arm or the like when it is used. **As shown in FIG. 32A, the pulse wave sensor is an optical reflective type sensor having the infrared LED 2021 to emit infrared light having a wavelength of about 940 nm, the green LED 2023 to emit green light having a wavelength of about 520 nm**, and the PD 2025 to receive light and output a signal corresponding to the amount of received light (photoreception signal). Sakai at 28:19-26

’304 Patent	Sakai
	FIG. 32A  Sakai at Fig. 32A One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Sakai discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above. FIG. 3 is a block diagram showing the construction of the monitor 1. As shown in FIG. 3, **the monitor 1 has an information detection unit 10 which emits light via the detection window 3 e and receives reflected light to thereby detect biological information;** an information processor 20 which processes the biological information detected by the information detection unit 10; and a battery 15 chargeable via the cable connected to the connector 3 f, which supplies power to the respective elements of the apparatus.

’304 Patent	Sakai
	Sakai at 5:4-12 FIG. 3  Sakai at Fig. 3 **The information detection unit 10 has an optical pulse wave and body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b;** a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20; a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data.

’304 Patent	Sakai
	Sakai at 5:13-24 Next, FIG. 13 is a block diagram showing the construction of the biological status detection apparatus. As shown in FIG. 13, **the biological status detection apparatus 1001 has an information detection unit 1010 which emits light via the light transmitting plate 1003 b and receives reflected light thereby detects biological information,** an information processor 1020 which processes the biological information detected by the information detection unit 1010, and a battery 1015 chargeable via the cable connected to the connector 1003 c, which supplies power to the respective elements of the apparatus. Sakai at 17:1-11 FIG. 13  Sakai at Fig. 13

’304 Patent	Sakai
	The information detection unit 1010 has an optical pulse wave sensor 1011 having a green LED 1011 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 1011 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), and a photo diode (PD) 1011 c to receive reflected light from the LEDs 1011 a and 1011 b; a driver 1012 which drives the LEDs 1011 a and 1011 b in accordance with instructions from the information processor 1020; a detector 1013 which drives the PD 1011 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 1014 which converts the detection signal from the detector 1013 into digital data. Sakai at 17:12-24 **Further, in the light transmitting plate 1003 b, a portion opposite to the green LED 1011 a and the photo diode 1011 c (hereinbelow, referred to as a “first portion”), i.e., a portion as a path of light emitted from the green LED 1011 a and its reflected light, is projected further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm).** By contrast, a portion opposite to the infrared LED 1011 b (hereinbelow, referred to as a “second portion”), i.e., a portion as a path of light emitted from the infrared LED 1011 b, has a shape dented further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm). Suppose the degree of adhesion to the test subject's skin when the apparatus 1001 is attached to the test subject, as shown in FIG. 14. Here, the degree of adhesion to the test subject's skin is high in the portion as a path of light emitted from the green LED 1011 a (green light) and its reflected light. By contrast, the degree of adhesion to the test subject's skin is low (or the portion is not in close contact with the skin) in the portion as a path of light emitted from the infrared LED 1011 b (infrared light). Sakai at 17:25-44 **When light emitted from the LEDs 1011 a and 1011 b to the test subject arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 1011 c as reflected light.** Sakai at 17:45-51

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Sakai discloses or renders obvious the measurement system of claim 15, wherein the first arc and the second arc are concentric. *See* claim 15 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Sakai discloses or renders obvious a wearable device for use with a smart phone or tablet, the wearable device. *See* 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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'304 Patent	Sakai
	incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	Sakai discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Sakai discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths. The information detection unit 10 has an optical pulse wave and **body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm),** and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b; a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20; a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. Sakai at 5:13-24 Further, **an apparatus using an optical pulse wave sensor to emit two types of lights having different wavelengths** is known (e.g., see JP-H7-88092 A (U.S. Pat. No. 6,022,321)). The apparatus discriminates a pulse component from a body motion component and detects exercise intensity of the living body or

’304 Patent	Sakai
	the like, from a ratio and the change of rate between amplitudes of peak frequency components included in the respective detection signals. **The detection signals are detected using the lights having different wavelengths.** Here, two facts are utilized, i.e, the first fact that the light absorption characteristic of blood component changes in correspondence with light wavelength, and the second fact that the motion of living body influences blood flow rate. Sakai at 16:3-15 The information detection unit 1010 has **an optical pulse wave sensor 1011 having a green LED 1011 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 1011 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm),** and a photo diode (PD) 1011 c to receive reflected light from the LEDs 1011 a and 1011 b; a driver 1012 which drives the LEDs 1011 a and 1011 b in accordance with instructions from the information processor 1020; a detector 1013 which drives the PD 1011 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 1014 which converts the detection signal from the detector 1013 into digital data. Sakai at 17:12-24 When the driver 1012 is started in accordance with a command from the information processor 1020, the driver 1012 drives the LEDs 1011 a and 1011 b alternately at different timings, by preset sampling interval (50 msec in the present embodiment). Further, **the driver 1012 controls the intensities of light emission from the LEDs 1011 a and 1011 b in accordance with commands from the information processor 1020.** Sakai at 18:35-41 The pulse wave sensor 2003 is fixed to human body's arm or the like when it is used. As shown in FIG. 32A, **the pulse wave sensor is an optical reflective type sensor having the infrared LED 2021 to emit infrared light having a wavelength of about 940 nm, the green LED 2023 to emit green light having a wavelength of about 520 nm,** and the PD 2025 to receive light and output a signal corresponding to the amount of received light (photoreception signal).

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	Sakai at 28:19-26 **Further, in the LEDs 1011 a and 1011 b to emit green light and infrared light, the amount of light can be controlled in accordance with the amplitude of pulse wave detection signal.** Sakai at 25:56-59 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Sakai discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are	Sakai disloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;

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’304 Patent	Sakai
off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;	*See* 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Sakai discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Sakai discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would

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'304 Patent	Sakai
	have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Sakai discloses or renders obvious increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[a], 11[b], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Sakai discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless	Sakai discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* 11[k], 19[pre].

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transmitter, a display, a voice input module, a speaker, and a touch screen; and	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link.	Sakai discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Sakai discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claims 13, 19 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Sakai discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claims 15, 20 above One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Sakai discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claims 16, 21 above One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D17

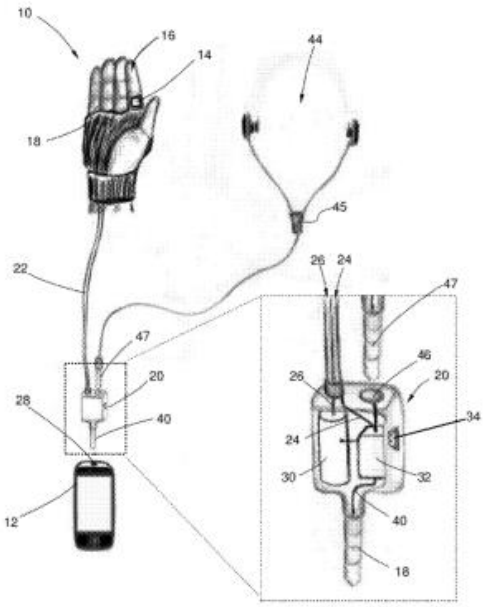
U.S. Pat. No. 10,874,304 in view of U.S. Patent No. 8,923,918 to Kevin Kreger ("Kreger")

As described in detail below, Kreger (individually or collectively) anticipates and/or renders obvious claims 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D16 and D18-D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. . This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Kreger. The cited portions of Kreger are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Kreger. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Kreger "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Kreger does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Kreger (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Kreger anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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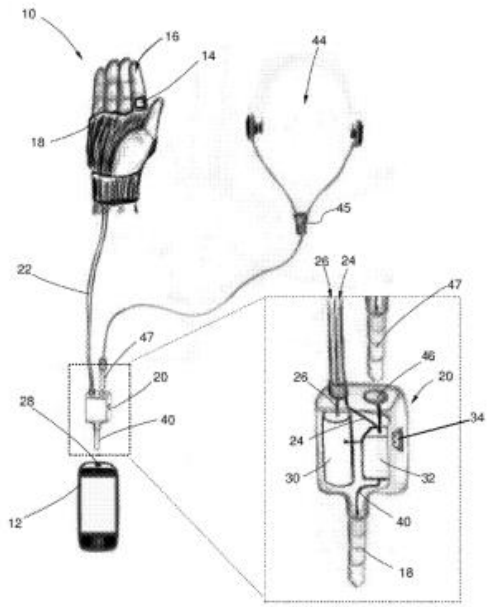
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Claim 11	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kreger discloses or renders obvious a measurement system.  FIG. 1 Kreger at Fig.1 The present invention pertains to biosensors that connect to a mobile communications device (“mobile”). such as a smart phone or portable media player, and more particularly, the present invention pertains to improvements to interfacing one or more biosensors to a mobile using the mobile's existing connectors. Kreger at 1:8-13 Mobile device technology has continuously improved in terms of processing power, storage capabilities, data transmission, and so forth. For example, **modern smart phones are capable of providing complex**

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	application support for biosensors by allowing storage, display, calculation of health parameters, and communication of the biosensor data from remote locations. Kreger at 1:51-57 **The present invention acts as an interface apparatus for various biosensors to utilize the electrical connectors of a mobile, such as a smart phone, so that the mobile becomes the heart of the biosensor monitoring system, either for sports/fitness or medical applications. Thus, the interface device receives at least one biosensor signal and has one or more mating connectors which mate with the mobile's electrical connectors. The electrical connector has a plurality of conductors with one or more of the conductors providing an input in communication with a mobile's processor. The interface device transforms the received biosensor signals to compatible electrical signals for the connectors' inputs.** Kreger at 1:58-2:2 In one aspect of another embodiment**, the biosensor interface apparatus further includes one or more biosensors. The biosensors may be electrodes including ECG electrodes, a photo plethysmograph (PPG), a pulse oximeter, a sphygmomanometer (inflatable blood pressure cuff), a thermometer/temperature sensor, a pedometer, a capnograph, a respiratory movement sensor, a respiratory flow sensor, a transdermal blood alcohol sensor, and a blood sugar sensor (glucometer). Thus it is an object to provide for a wide range of common medical and sport/fitness biosensors in a single compact interface apparatus**. Kreger at 3:24-34 In one aspect of another embodiment, **the biosensor interface apparatus further includes one or more biosensor connectors capable of receiving a biosensor signal. Thus it is an object to provide an interface apparatus that supports biosensors' industry standard and manufacturer specified probe connectors, thereby improving the invention's usability and promoting reuse of existing biosensor probes**. Kreger at 3:35-41

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	In one aspect of another embodiment, **the biosensor interface apparatus further includes at least one connector capable of receiving a biosensor signal, wherein the biosensor signal is an electrical signal, a chemical signal, a gas signal, or a force signal. Thus, it is one object to provide for transmission of gas, chemical compounds, or force such as through a tube in order to measure, for example, end-tidal CO2 (ETCO2), respiratory rate (RR), or respiratory flow with a capnograph. It is another object to provide for the transmission of an electrical signal such as from an ECG or pulse oximeter. In addition vibrations and other audible and inaudible force may be detected by a force sensor that could be in communication with a stethoscope or accelerometer.** Kreger at 3:42-54 **With reference to FIG. 1, there is shown a first embodiment of the biosensor interface apparatus for use with a mobile communication device 10. The biosensor 14 produces one or more biosensor signals transmitted via cable 22 and received by interface device 20. The interface device transforms the biosensor signals so that they can be conducted via electrical connector 28 and compatibly received by the mobile communications device shown as smart phone 12.** Kreger at 5:40-47

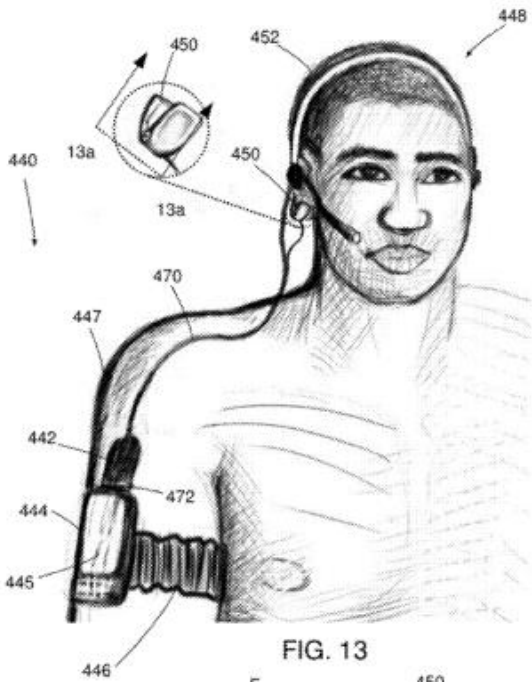
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	 FIG. 1 Kreger at Fig.1 **In other embodiments, the mobile communications device can be any of a number of mobile phones such as an iPhone® or an Android® phone, a personal digital assistant (PDA) such as a Blackberry®, a portable audio playback device such as an MP3 player, a portable media playback device such as an iPod®, or a handheld tablet such as an iPad®.** Kreger at 5:48-53 **Continuing with FIG. 1, the biosensor is shown as a pulse oximeter 14 in communication with finger 16. The pulse oximeter may provide a pulse signal to calculate BPM, a SPO2 reading, or a diagnostic cardiac waveform. The pulse oximeter 14 may be retained against the base of finger 16 using a mounting device that may be worn on the finger or hand, shown as gauntlet 18. Alternatively, the pulse oximeter may be worn on the fingertip, ear, forehead, or nasal septum using various mounting devices such as rings, clips, elastic straps, and adhesive pads.**

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	Kreger at 5:54-63 Continuing to refer to FIG. 3, the microprocessor 74 receives one or more biosensor signals and may transform the data into a biosensor measurement such as BPM, or an oth erwise useful signal such as a ECG signal suitable for medical diagnosis. The signals and measurements may be stored in memory 12 and may be used for plotting on display 94. The signals and measurements may also be used to provide infor mation such as a BPM via speaker 98 or via a headset or earpiece (not shown). In addition, biosensor data may be produced by the mobile's internal accelerometer 70 if it is in communication with a human body, thereby serving as a biosensor that may be used to determine the patient's position, respiratory movement, and so forth. Kreger at 7:26-38. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Kreger discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths. **With reference to FIG. 1, there is shown a first embodiment of the biosensor interface apparatus for use with a mobile communication device 10.** The biosensor 14 produces one or more biosensor signals transmitted via cable 22 and received by interface device 20**. The interface device transforms the biosensor signals so that they can be conducted via electrical connector 28 and compatibly received by the mobile communications device shown as smart phone 12.** Kreger at 5:40-47

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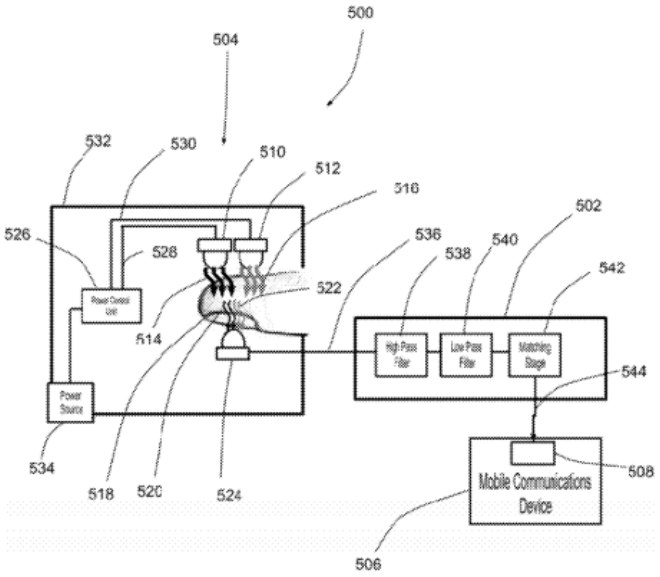
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	Continuing with FIG. 1, the biosensor is shown as a pulse oximeter 14 in communication with finger 16. The pulse oximeter may provide a pulse signal to calculate BPM, a SPO2 reading, or a diagnostic cardiac waveform. The pulse oximeter 14 may be retained against the base of finger 16 using a mounting device that may be worn on the finger or hand, shown as gauntlet 18. Alternatively, the pulse oximeter may be worn on the fingertip, ear, forehead, or nasal septum using various mounting devices such as rings, clips, elastic straps, and adhesive pads. Kreger at 5:54-63  FIG. 13 Kreger at Fig.13 Turning now to FIG. 13, an embodiment of the interface apparatus 440 comprises an interface device 442 that may connect multiple medical or other biosensors to a mobile device such as smart phone 444 via electrical connector, for example 472. **The biosensors may include a sphygmomanometer such as inflatable blood pressure cuff 446 to measure or monitor the user's blood pressure. The blood**

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	pressure cuff 446 may be in communication with the user's arm 447 and may also house or otherwise carry mobile 444. The embodiment of interface apparatus 440 may also have an integral headset 448 worn by user 452, and a PPG 450, for example, attached to the user's earlobe. Mobile device smart phone 444 may derive measurements and display plots of the biosensor data on its display 445. Smart phone 444 may also transmit the patient's biosensor data and measurements using one or more internal RF transmitters, for example, over the mobile's data network, or as as modulated data, using frequency shift key (FSK), phase shift key (PSK) encoding or like modulation schemes over the mobile's voice network. In addition, the mobile 444 may transmit the data over a serial cable or an RF bluetooth channel, to a PC or other computing device, or via various other such wireless and wired interfaces, such as 3G, 4G, wired and wireless Ethernet and the like. Kreger at 12:5-28 Referring to FIGS. 1 and 2, the biosensor 14 may be in communication with the interface device 20 via cable 22. The cable may contain one or more conductors 24, 26**. The cable 22 may transmit power to the pulse oximeter 14 via conductor 26, or may transmit biosensor signals, such as the two absorption light signals from the pulse oximeter 14, via conductor 24.** Kreger at 5:64-6:3 The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27**. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown).** Kreger at 8:9-25

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	Turning now to FIG. 13 a, a cross section of photo plethysmograph 450 taken along axes 13 a is shown. **The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455**, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47 Turning now to FIG. 15, a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, **the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal.** The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth. Kreger at 13:4-29

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	The pulse oximeter output signal 558 may be multiplexed with accelerometer signal 560 by multiplexer 562. Recall that the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526. Similarly, power control unit 564 may supply a signal to the multiplexor 562 to time multiplex the accelerometer and pulse oximeter signals 566 into a combined signal 567. Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals combined in pulse ox output 558 and the accelerometer output 569 into their three individual components (and perhaps more for additional accelerometer outputs). The power control unit 564 may provide a synchronizing signal such as 568 to the mobile device 556 to demultiplex the pulse oximeter data and accelerometer data. The synchronizing signal 568 may be further combined with the sensor data by another multiplexer 576. Kreger at 14:33-48  FIG. 17 Kreger at Fig.17

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	Continuing with FIG. 17, **the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502.** Kreger at 13:36-50 Referring to FIGS. 17 and 18, **to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown in plots 523, 525. The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526.** Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525. The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506 to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below). Kreger at 13:51-64 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Kreger discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. **The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150.** The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Turning now to FIG. 13 a, **a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47 Turning now to FIG. 15, **a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains**

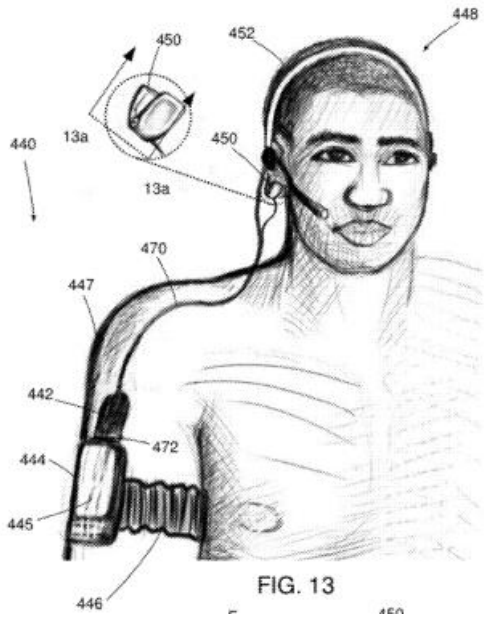
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	a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. **Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth**. Kreger at 13:4-29 Thus, it is another object to provide compatible signals to the **mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise and drif**t, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth. Kreger at 3:17-23 The interface device 20 may also provide a sensors interface circuit 42 which receives biosensor signals on input conductor 24 and transforms the signals to output electrical signals 43 that are output on electrical connector 28. **The interface circuit provides output electrical signals 43 signals that are electrically compatible, for example, with respect to impedance, voltage amplitude, noise levels**, and so forth such that the signals can be received by the mobile's processor via connector 24. Kreger at 6:22-30

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	Still referring to FIGS. 17 and 18, **the interface device 502 may receive pulse oximeter and other sensors signals on conductors 536 and perform various transformations on the signals. For example, high frequency noise may be reduced with high pass filter538, DC offsets and baseline wander can may be reduced with a low pass filter 440, These filters may be instrumental in creating a signal which is usable for examples as a diagnostic display, an SPO2 calculation, a BPM calculation, and so forth**. Internal mobile device filters, for example such as an anti-aliasing filter for recording inputs or a CODEC filter may be used. Alternatively, internal filters can be reconfigured or disabled to allow, for example, the reception of lower frequency signals by the mobile 12 CODEC 76 or AtoD converter 78. Kreger at 14:4-17 Still referring to FIG. 19, the interface device 552 may receive pulse oximeter, other sensors signals, and synchronizing signals on conductors 567, 568 and perform various transformations on the signals**. For example, high frequency noise, DC offsets and baseline wander may be reduced with a band pass filter570. In addition, proper matching of the electrical characteristics of mobile's electrical connector may provided by matching stage 572, for example, as provided by matching stage 542 above.** Kreger at 14:49-57 **The photo plethysmograph output signal and temperature sensor signal may be communicated from sensors assembly 587 by separate (i.e. parallel) conductors 588, 590 to interface device 582. High frequency noise, DC offsets and baseline wander may be reduced with anti-alias filters592, 593.** The filtered signals are received by the serial AtoD converter 594, which converts them to digital values that are serialized for transmission to serial electrical connector 588 on mobile 586. Kreger at 14:65-15:5 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Kreger discloses or renders obvious a the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. **Continuing with FIG. 1, the biosensor is shown as a pulse oximeter 14 in communication with finger 16. The pulse oximeter may provide a pulse signal to calculate BPM, a SPO2 reading, or a diagnostic cardiac waveform. The pulse oximeter 14 may be retained against the base of finger 16 using a mounting device that may be worn on the finger or hand, shown as gauntlet 18. Alternatively, the pulse oximeter may be worn on the fingertip, ear, forehead, or nasal septum using various mounting devices such as rings, clips, elastic straps, and adhesive pads.** Kreger at 5:54-63  FIG. 13 Kreger at Fig.13

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	Turning now to FIG. 13, an embodiment of the interface apparatus 440 comprises an interface device 442 that may connect multiple medical or other biosensors to a mobile device such as smart phone 444 via electrical connector, for example 472. **The biosensors may include a sphygmomanometer such as inflatable blood pressure cuff 446 to measure or monitor the user's blood pressure. The blood pressure cuff 446 may be in communication with the user's arm 447 and may also house or otherwise carry mobile 444. The embodiment of interface apparatus 440 may also have an integral headset 448 worn by user 452, and a PPG 450, for example, attached to the user's earlobe.** Mobile device smart phone 444 may derive measurements and display plots of the biosensor data on its display 445. Smart phone 444 may also transmit the patient's biosensor data and measurements using one or more internal RF transmitters, for example, over the mobile's data network, or as as modulated data, using frequency shift key (FSK), phase shift key (PSK) encoding or like modulation schemes over the mobile's voice network. In addition, the mobile 444 may transmit the data over a serial cable or an RF bluetooth channel, to a PC or other computing device, or via various other such wireless and wired interfaces, such as 3G, 4G, wired and wireless Ethernet and the like. Kreger at 12:5-28 **The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150.** The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Turning now to FIG. 13 a, **a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a**

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	light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47 Turning now to FIG. 15, **a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. **Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth**. Kreger at 13:4-29 Continuing with FIG. 17, the pulse oximeter 504 has, for example, **two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths**

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	of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502. Kreger at 13:36-50. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d]. the wearable measurement device further comprising a receiver configured to:	Kreger discloses or renders obvious the wearable measurement device further comprising a receiver. The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. **Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow**) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25

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	Turning now to FIG. 13 a, a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. **The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460.** Kreger at 12:29-47 The PPG 450 may releaseably attach to the user's earlobe 456 by using a biasing element 464 that provides forces Fa and Fb which grip earlobe 456 between opposing elements 466, 468. Elements 466, 468 may also house IR LED 452, power control unit 454, l**ight receiving device 458, motion/temperature sensor 462, and the like**. Additionally, PPG 450 is connected via conductors 470 to interface device 442, which may transmit one or more sensor signals and power. Kreger at 12:48-55. Turning now to FIG. 15, a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. **The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491.** The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456

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	by using a mounting or retaining device such as hat 483 worn by user 489. Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth. Kreger at 13:4-29. Continuing with FIG. 17, the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. **The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502.** Kreger at 13:36-50 In one aspect of another embodiment (not shown), **the biosensor interface apparatus further includes at least on least one receiver capable of receiving a wireless biosensor signal.** The interface apparatus acts as an adapter for the wireless biosensor to utilize the capabilities of the mobile's electrical connectors. Importantly, wireless RF biosensors may need access to the mobile via its electrical connector, for example, with an iPhone® to avoid licensing issues. Kreger at 16:6-13 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample,	Kreger discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. **Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b.** Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Referring now to FIG. 8, an embodiment of the biosensor interface apparatus 190 may be integrated into an emergency or pre-hospital critical care monitor having multiple biosensors. The biosensors are arranged so that the patient 192 may be wearing an ECG electrode retaining device such as garment 193 that holds cloth or textile ECG electrodes 192, 194, 196, 198 in communication with the patient's skin. There also may be an thermal sensor 202 for measuring the patient's body temperature (shown under the patient's arm), and a movement sensor accelerometer 204, which is in communication with the patient's thorax 206 measuring thoracic movement as a respiratory monitor. **The interface device 208 receives the biosensor signals via electrical cable 210, processes the signals, and outputs them to the mobile communication device 212 via one or more electrical connectors.** Various sensor signals and measurements may be displayed on the mobile's screen 214 such as electrocardiogram (ECG) 216, heart rate (BPM) 218, respiratory movement 220, respiratory rate (RR) 224, and body temperature (degrees Fahrenheit or Centigrade) 222. In another embodiment the connection of cable 210 to interface device 208 may have releasable connectors either for a single electrical cable such as 210, or as individual sensor connectors. In another embodiment one or more sensors communicate with the interface device 208 wirelessly such as with bluetooth-capable sensors. In another alternative embodiment, the patient is using

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	adhesive ECG electrodes, and there is no retaining garment 193. In yet another embodiment the accelerometer 204 can be used to determine periods of activity, rest, and cessation of patient movement, as well as patient position. The movement sensor 204 can also track user 192 position, velocity and acceleration, either of a patient or a fitness user. Kreger at 9:9-40 The biosensor signals 244 are received by mobile 212 through dock connector 246 which is in communication with an electrical connector on mobile 212 (not visible). **The signals may be processed by the interface device dock 242 before being communicated to mobile 212. The biosensor signals may be further processed by the mobile 212 to produce measurements such as BPM 264 or for plotting signals for medical diagnosis such as ECG 266 and respiratory end-tidal CO2 (ETCO2) 267. Biosensor signals may also be received by one or more RF receivers in the dock 246 (not shown) and communicated to the mobile 212 via wired electrical connector 246, for example, to** allow the wireless sensor to utilize the features of the wired audio input's anti-alias filters and analog to digital converter as will be explained in detail below. Kreger at 10:14-28 Turning now to FIG. 13 a, a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. **The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460.** Kreger at 12:29-47

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	Turning now to FIG. 15, a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. **The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491.** The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth. Kreger at 13:4-29. Continuing with FIG. 17, the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. **The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502.** Kreger at 13:36-50. Referring to FIGS. 17 and 18, to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown

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	in plots 523, 525. **The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526. Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525**. The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506 to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below). Kreger at 13:51-64. In one aspect of another embodiment (not shown), **the biosensor interface apparatus further includes at least on least one receiver capable of receiving a wireless biosensor signal.** The interface apparatus acts as an adapter for the wireless biosensor to utilize the capabilities of the mobile's electrical connectors. Importantly, wireless RF biosensors may need access to the mobile via its electrical connector, for example, with an iPhone® to avoid licensing issues. Kreger at 16:6-13. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample,	Kreger disloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample. The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. **The photodiode electrical output**

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	(i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Referring now to FIG. 8, an embodiment of the biosensor interface apparatus 190 may be integrated into an emergency or pre-hospital critical care monitor having multiple biosensors. The biosensors are arranged so that the patient 192 may be wearing an ECG electrode retaining device such as garment 193 that holds cloth or textile ECG electrodes 192, 194, 196, 198 in communication with the patient's skin. There also may be an thermal sensor 202 for measuring the patient's body temperature (shown under the patient's arm), and a movement sensor accelerometer 204, which is in communication with the patient's thorax 206 measuring thoracic movement as a respiratory monitor. **The interface device 208 receives the biosensor signals via electrical cable 210, processes the signals, and outputs them to the mobile communication device 212 via one or more electrical connectors. Various sensor signals and measurements may be displayed on the mobile's screen 214 such as electrocardiogram (ECG) 216, heart rate (BPM) 218, respiratory movement 220, respiratory rate (RR) 224, and body temperature (degrees Fahrenheit or Centigrade) 222. I**n another embodiment the connection of cable 210 to interface device 208 may have releasable connectors either for a single electrical cable such as 210, or as individual sensor connectors. In another embodiment one or more sensors communicate with the interface device 208 wirelessly such as with bluetooth-capable sensors. In another alternative embodiment, the patient is using adhesive ECG electrodes, and there is no retaining garment 193. In yet another embodiment the accelerometer 204 can be used to determine periods of activity, rest, and cessation of patient movement, as well as patient position. The movement sensor 204 can also track user 192 position, velocity and acceleration, either of a patient or a fitness user. Kreger at 9:9-40 The biosensor signals 244 are received by mobile 212 through dock connector 246 which is in communication with an electrical connector on mobile 212 (not visible). **The signals may be processed by the interface device dock 242 before being communicated to mobile 212. The biosensor signals may be further processed by the mobile 212 to produce measurements such as BPM 264 or for**

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	plotting signals for medical diagnosis such as ECG 266 and respiratory end-tidal CO2 (ETCO2) 267. Biosensor signals may also be received by one or more RF receivers in the dock 246 (not shown) and communicated to the mobile 212 via wired electrical connector 246, for example, to allow the wireless sensor to utilize the features of the wired audio input's anti-alias filters and analog to digital converter as will be explained in detail below. Kreger at 10:14-28 The biosensor signals 344 are received by a mobile device such as a tablet 312 through dock connector 346 which is in communication with an electrical connector on tablet 312 (not visible). The signals may be processed by the interface device dock 342 before being communicated to tablet 312. **The biosensor signals may be further processed by the tablet 312 to produce displayed measurements such as BPM 364, diastolic and systolic blood pressure 370, respiratory rate 372, and the like. As well, the biosensor signals may be plotted or otherwise displayed, either with further processing by tablet 312, or plotted in the form received from dock 342. For example, biosensor signals may be displayed by tablet 312 such as those used for medical diagnosis and monitoring: ECG 366, PPG cardiac signal 374, respiratory motion 376, end-tidal CO2 (ETCO2) 378, and the like.** Biosensor signals may also be received by one or more RF receivers in the dock 346 (not shown) and communicated to the tablet 312 via wired electrical connector 346, for example, to allow the wireless sensor to utilize the features of the wired audio input's anti-alias filters and analog to digital converter. Interface device dock 342 may also include a support 368 for retaining the mobile 312 in communication with connector 346. Kreger at 10:59-11:14. Turning now to FIG. 13 a, a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. **The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** In one embodiment the light

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	receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47 Turning now to FIG. 15, a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. **The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491.** The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth. Kreger at 13:4-29. Continuing with FIG. 17, the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. **The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502.**

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	Kreger at 13:36-50. Referring to FIGS. 17 and 18, to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown in plots 523, 525. **The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526. Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525**. **The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506** to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below). Kreger at 13:51-64. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	Kreger discloses or renders obvious the receiver configured to synchronize to the light source. In one aspect of this embodiment the interface device trans forms the received biosensor signals to compatible electrical signals for the connectors’ inputs by one or more of the following: DC voltage cancellation, filtration, attenuation, demodulation, modulation, compression, amplification, expansion, digitization, serialization, demultiplex, multiplex, Switching, synchronization, electrical isolation, and impedance matching. Thus, it is another object to provide compatible signals to the mobile's electrical connectors which may involve trans forming the biosensor signals to match requisite impedance and signal levels, eliminate

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	noise, cancel DC noise and drift, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth. Kreger at 3:8-23 **The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150.** The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Turning now to FIG. 13 a, **a** cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers**. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47

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	Turning now to FIG. 15, a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492**. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth. Kreger at 13:4-29 Thus, it is another object to provide compatible signals to the **mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise and drif**t, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, **synchronization**, and so forth. Kreger at 3:17-23 The interface device 20 may also provide a sensors interface circuit 42 which receives biosensor signals on input conductor 24 and transforms the signals to output electrical signals 43 that are output on electrical connector 28. **The interface circuit provides output electrical signals 43 signals that are electrically compatible, for example, with respect to impedance, voltage amplitude, noise levels**, and so forth such that the signals can be received by the mobile's processor via connector 24. Kreger at 6:22-30

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	Still referring to FIGS. 17 and 18, **the interface device 502 may receive pulse oximeter and other sensors signals on conductors 536 and perform various transformations on the signals.** For example, high frequency noise may be reduced with high pass filter538, DC offsets and baseline wander can may be reduced with a low pass filter 440, These filters may be instrumental in creating a signal which is usable for examples as a diagnostic display, an SPO2 calculation, a BPM calculation, and so forth. Internal mobile device filters, for example such as an anti-aliasing filter for recording inputs or a CODEC filter may be used. Alternatively, internal filters can be reconfigured or disabled to allow, for example, the reception of lower frequency signals by the mobile 12 CODEC 76 or AtoD converter 78. Kreger at 14:4-17 The power control unit 564 may provide a synchronizing signal such as 568 to the mobile device 556 to demultiplex the pulse Oximeter data and accelerometer data. The synchronizing signal 568 may be further combined with the sensor data by another multiplexer 576. Kreger at 14:43-48. Still referring to FIG. 19, the interface device 552 may receive pulse oximeter, other sensors signals, and synchronizing signals on conductors 567, 568 and perform various transformations on the signals**. For example, high frequency noise, DC offsets and baseline wander may be reduced with a band pass filter570. In addition, proper matching of the electrical characteristics of mobile's electrical connector may provided by matching stage 572, for example, as provided by matching stage 542 above.** Kreger at 14:49-57 **The photo plethysmograph output signal and temperature sensor signal may be communicated from sensors assembly 587 by separate (i.e. parallel) conductors 588, 590 to interface device 582.** High frequency noise, DC offsets and baseline wander may be reduced with anti-alias filters592, 593. The filtered signals are received by the serial AtoD converter 594, which converts them to digital values that are serialized for transmission to serial electrical connector 588 on mobile 586. Kreger at 14:65-15:5

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the captured light into a first signal,	Kreger discloses or renders obvious the receiver configure to capture light while the semiconductor sources are off and convert the captured light into a first signal. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Kreger discloses or renders obvious the receiver configure to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. **Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface**

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	device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Referring now to FIG. 8, an embodiment of the biosensor interface apparatus 190 may be integrated into an emergency or pre-hospital critical care monitor having multiple biosensors. The biosensors are arranged so that the patient 192 may be wearing an ECG electrode retaining device such as garment 193 that holds cloth or textile ECG electrodes 192, 194, 196, 198 in communication with the patient's skin. There also may be an thermal sensor 202 for measuring the patient's body temperature (shown under the patient's arm), and a movement sensor accelerometer 204, which is in communication with the patient's thorax 206 measuring thoracic movement as a respiratory monitor. **The interface device 208 receives the biosensor signals via electrical cable 210, processes the signals, and outputs them to the mobile communication device 212 via one or more electrical connectors.** Various sensor signals and measurements may be displayed on the mobile's screen 214 such as electrocardiogram (ECG) 216, heart rate (BPM) 218, respiratory movement 220, respiratory rate (RR) 224, and body temperature (degrees Fahrenheit or Centigrade) 222. In another embodiment the connection of cable 210 to interface device 208 may have releasable connectors either for a single electrical cable such as 210, or as individual sensor connectors. In another embodiment one or more sensors communicate with the interface device 208 wirelessly such as with bluetooth-capable sensors. In another alternative embodiment, the patient is using adhesive ECG electrodes, and there is no retaining garment 193. In yet another embodiment the accelerometer 204 can be used to determine periods of activity, rest, and cessation of patient movement, as well as patient position. The movement sensor 204 can also track user 192 position, velocity and acceleration, either of a patient or a fitness user. Kreger at 9:9-40 The biosensor signals 244 are received by mobile 212 through dock connector 246 which is in communication with an electrical connector on mobile 212 (not visible). **The signals may be processed by the interface device dock 242 before being communicated to mobile 212. The biosensor signals may be further processed by the mobile 212 to produce measurements such as BPM 264 or for plotting signals for medical diagnosis such as ECG 266 and respiratory end-tidal CO2 (ETCO2) 267. Biosensor signals may also be received by one or more RF receivers in the dock 246 (not**

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	shown) and communicated to the mobile 212 via wired electrical connector 246, for example, to allow the wireless sensor to utilize the features of the wired audio input's anti-alias filters and analog to digital converter as will be explained in detail below. Kreger at 10:14-28 Turning now to FIG. 13 a, a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. **The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460.** Kreger at 12:29-47 Turning now to FIG. 15, a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. **The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491.** The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or

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	more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth. Kreger at 13:4-29. Continuing with FIG. 17, the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. **The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502.** Kreger at 13:36-50. Referring to FIGS. 17 and 18, to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown in plots 523, 525. **The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526. Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525**. The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506 to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below). Kreger at 13:51-64. In one aspect of another embodiment (not shown), **the biosensor interface apparatus further includes at least on least one receiver capable of receiving a wireless biosensor signal.** The interface apparatus acts as an adapter for the wireless biosensor to utilize the capabilities of the mobile's electrical connectors. Importantly, wireless RF biosensors may need access to the mobile via its electrical connector, for example, with an iPhone® to avoid licensing issues.

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	Kreger at 16:6-13. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Kreger discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. Turning now to FIG. 15, **a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. **Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth**. Kreger at 13:4-29

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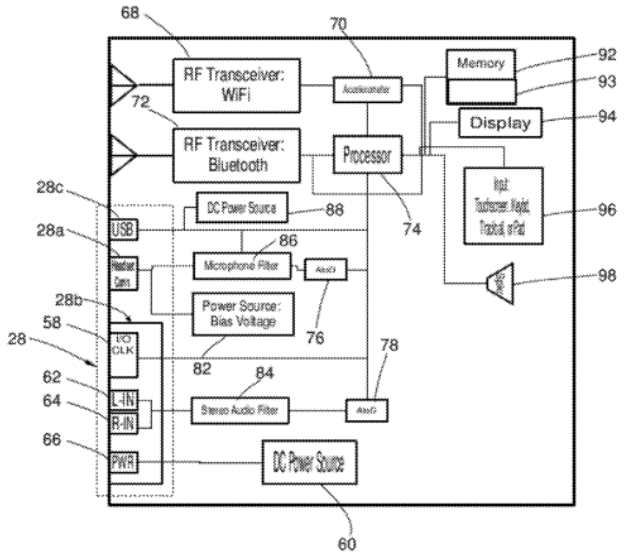
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	Thus, it is another object to provide compatible signals to the **mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise and drif**t, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth. Kreger at 3:17-23 The interface device 20 may also provide a sensors interface circuit 42 which receives biosensor signals on input conductor 24 and transforms the signals to output electrical signals 43 that are output on electrical connector 28. **The interface circuit provides output electrical signals 43 signals that are electrically compatible, for example, with respect to impedance, voltage amplitude, noise levels**, and so forth such that the signals can be received by the mobile's processor via connector 24. Kreger at 6:22-30 Still referring to FIGS. 17 and 18, **the interface device 502 may receive pulse oximeter and other sensors signals on conductors 536 and perform various transformations on the signals. For example, high frequency noise may be reduced with high pass filter538, DC offsets and baseline wander can may be reduced with a low pass filter 440, These filters may be instrumental in creating a signal which is usable for examples as a diagnostic display, an SPO2 calculation, a BPM calculation, and so forth**. Internal mobile device filters, for example such as an anti-aliasing filter for recording inputs or a CODEC filter may be used. Alternatively, internal filters can be reconfigured or disabled to allow, for example, the reception of lower frequency signals by the mobile 12 CODEC 76 or AtoD converter 78. Kreger at 14:4-17 Still referring to FIG. 19, the interface device 552 may receive pulse oximeter, other sensors signals, and synchronizing signals on conductors 567, 568 and perform various transformations on the signals**. For example, high frequency noise, DC offsets and baseline wander may be reduced with a band pass filter570. In addition, proper matching of the electrical characteristics of mobile's electrical connector may provided by matching stage 572, for example, as provided by matching stage 542 above.**

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	Kreger at 14:49-57 **The photo plethysmograph output signal and temperature sensor signal may be communicated from sensors assembly 587 by separate (i.e. parallel) conductors 588, 590 to interface device 582. High frequency noise, DC offsets and baseline wander may be reduced with anti-alias filters592, 593.** The filtered signals are received by the serial AtoD converter 594, which converts them to digital values that are serialized for transmission to serial electrical connector 588 on mobile 586. Kreger at 14:65-15:5 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed	Kreger discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. **19. The bio sensor interface apparatus of claim 1 further comprising a cell phone display with the processor configured to communicate the measurement to the display.** Kreger at claim 19 The present invention pertains to biosensors that connect to a mobile communications device (“mobile”). such as a smart phone or portable media player, and more particularly, the present invention pertains to improvements to interfacing one or more biosensors to a mobile using the mobile's existing connectors.

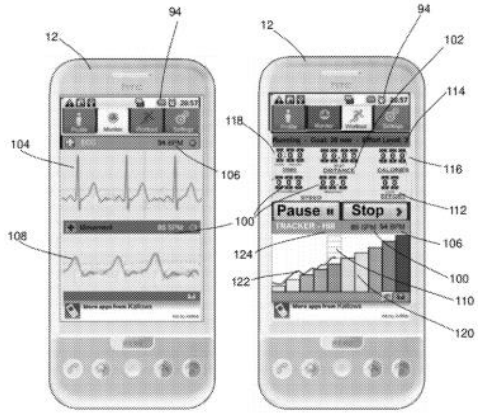
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output signal over a wireless transmission link; and	Kreger at 1:8-13 Thus, it is one object of the apparatus to provide a simple, inexpensive device for monitoring biosensors that utilizes the smartphone and its associated capabilities including its processing power and the data input capabilities of its electrical connectors. Kreger at 2:16-20 **In alternative embodiments the mobile communication device may be a mobile phone, a personal digital assistant, a smartphone, a portable media playback device, a handheld tablet, and the like. Thus, it is one object of the device to provide for an flexible interface apparatus that will be compatible with a variety of mobile communications devices.** Kreger at 2:21-26 **With reference to FIG. 1, there is shown a first embodiment of the biosensor interface apparatus for use with a mobile communication device 10. The biosensor 14 produces one or more biosensor signals transmitted via cable 22 and received by interface device 20. The interface device transforms the biosensor signals so that they can be conducted via electrical connector 28 and compatibly received by the mobile communications device shown as smart phone 12.** Kreger at 5:40-47 **In other embodiments, the mobile communications device can be any of a number of mobile phones such as an iPhone® or an Android® phone, a personal digital assistant (PDA) such as a Blackberry®, a portable audio playback device such as an MP3 player, a portable media playback device such as an iPod®, or a handheld tablet such as an iPad®.** Kreger at 5:48-53 Turning now to FIG. 3, a mobile communications device 12 of the present invention is shown as a block diagram. The biosensor signals may be received by one or more electrical connectors 28 on the mobile

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	12 and communicated to the processor 16 whereupon the microprocessor produces a biosensor measurement or a biosensor signal for analysis. Kreger at 6:55-60 **The sensor data and measurements may be transmitted to remote medical personnel, internet servers, and others using WiFi transceiver 68, Bluetooth transceiver 72 or other RF transmitter such as for a cellular phone network. As well, the signals and measurements on the mobile 12 may be transferred via a cable connected to USB connector 28 c or docking connector 28 b to another computer storage device, over a computer network, to a personal computer, and so forth.** Kreger at 7:39-46  FIG. 3 Kreger at Fig.3 **Turning now to FIG. 3, a mobile communications device 12 of the present invention is shown as a block diagram. The biosensor signals may be received by one or more electrical connectors 28 on**

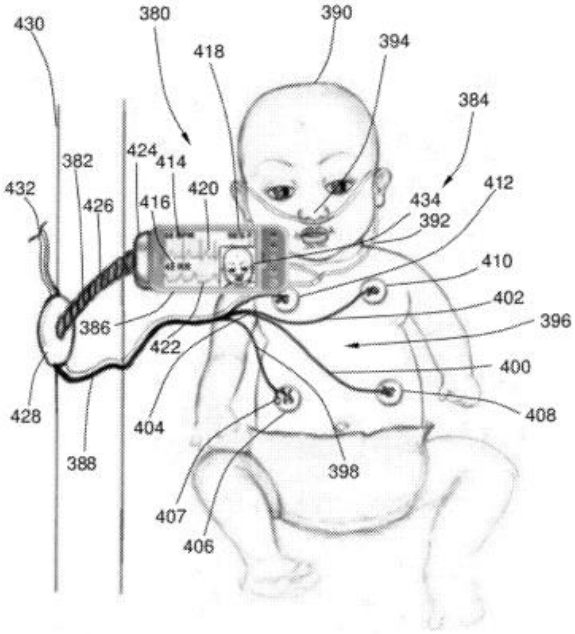
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	the mobile 12 and communicated to the processor 16 whereupon the microprocessor produces a biosensor measurement or a biosensor signal for analysis. The electrical connectors 28 are shown as a headset audio connector 28 a (providing a microphone input and at least one audio output); a hybrid power, data and audio connector 28 b (aka docking connector); and USB connector 28 c. Although the USB connector 28 c may provide data communications, it may also double as a headset connector. The docking connector 28 b may be comprised of connections that allow recording high quality with audio inputs 62, 64; provide a source of DC power 60 via power connection 66; and provide other data input/output (“I/O”) via I/O and clock connections 58. **The sensor data and measurements may be transmitted to remote medical personnel, internet servers, and others using WiFi transceiver 68, Bluetooth transceiver 72 or other RF transmitter such as for a cellular phone network. As well, the signals and measurements on the mobile 12 may be transferred via a cable connected to USB connector 28 c or docking connector 28 b to another computer storage device, over a computer network, to a personal computer, and so forth.** Kreger at 7:39-46 **Referring now to FIGS. 4 a and 4 b and also to FIG. 3, the microprocessor 74 may drive a display 94 to display the biosensor signals and measurements derived there from. For example a movement sensor may be used to determine the speed 100 (strides per minute or SPM) or distance traveled 102 by an athlete during a workout. A cardiac sensor my provide an ECG signal 104 which can be used to calculate the heart rate 106.** The speed 100 can be used separately, but preferably in tandem, to perform a cardiac stress exam and determine a patient's stress level. Speed 100 and/or heart rate 106 may also be used to monitor and control an effort level 110, 112 in a workout. As well, effort level 114 may be a target that is set for the workout. Goals may be set and measurements may be displayed on, for example, a workout timer 112, which may show elapsed or remaining time and may have controls to set workout time. Moreover, other measurements such as Calories 116 may be displayed as “Calories elapsed” or “Calories remaining until goal”. Similarly for elapsed or remaining distance 102, a distance goal can be set, for example, in strides, miles, or kilometers. As well, for effort where an actual effort level 122 and a target effort level 120 can be shown graphically and the user may choose a certain effort profile or course such as Hill 124.

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	Kreger at 7:47-8:2 **The electrical PPG signal 174 a is communicated to headset interface circuit 176, which may further condition the signal, for example to match an electrical circuit impedance. As well, the headset interface circuit connects or switches the resulting signal to output conductor 29 a. The headset interface circuit may also connect the headset speakers 178 and microphone 180 to output conductor 29 a**. The headset interface circuit may also combine or multiplex the microphone signal 182 and the PPG signal 174 a to output conductor 29 a. Kreger at 8:52-60  FIG. 4a FIG. 4b Kreger at Fig.4A and 4B Turning now to FIGS. 6 and 7, **an embodiment of the biosensor interface apparatus 160 may be integrated into a mobile headset 162 having speakers 178 for the ear and a microphone 180, but also having a sensors assembly 164. The sensors assembly 164 may have a cardiac sensor and a movement sensor, for example, a PPG and an accelerometer. In this embodiment the sensors assembly 164 receives power from and communicates signals to the interface device 166 as follows: PPG signal on conductor 26 a, one or more accelerometer signals on conductors 26 b, and power on conductor 27.** Furthermore, power source 168 on interface device 166, which supplies power on

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	conductor 27, may also supply power to the other circuits on the interface device 166, and may receive power via power charging circuit 170. Power charging circuit 170 may receive power from mobile communications device 12, for example, from a microphone bias voltage via headset connector 28 a, or from a power source on docking connector 28 b. In alternative embodiments the power source 168 may be external or it may be within mobile 12, sensors assembly 164, and/or interface device 166. Kreger at 8:26-45 Referring now to FIG. 8, an embodiment of the biosensor interface apparatus 190 may be integrated into an emergency or pre-hospital critical care monitor having multiple biosensors. **The biosensors are arranged so that the patient 192 may be wearing an ECG electrode retaining device such as garment 193 that holds cloth or textile ECG electrodes 192, 194, 196, 198 in communication with the patient's skin**. There also may be an thermal sensor 202 for measuring the patient's body temperature (shown under the patient's arm), and a movement sensor accelerometer 204, which is in communication with the patient's thorax 206 measuring thoracic movement as a respiratory monitor. The interface device 208 receives the biosensor signals via electrical cable 210, processes the signals, and outputs them to the mobile communication device 212 via one or more electrical connectors. **Various sensor signals and measurements may be displayed on the mobile's screen 214 such as electrocardiogram (ECG) 216, heart rate (BPM) 218, respiratory movement 220, respiratory rate (RR) 224, and body temperature (degrees Fahrenheit or Centigrade) 222. In another embodiment the connection of cable 210 to interface device 208 may have releasable connectors either for a single electrical cable such as 210, or as individual sensor connectors. In another embodiment one or more sensors communicate with the interface device 208 wirelessly such as with bluetooth-capable sensors.** In another alternative embodiment, the patient is using adhesive ECG electrodes, and there is no retaining garment 193. In yet another embodiment the accelerometer 204 can be used to determine periods of activity, rest, and cessation of patient movement, as well as patient position. The movement sensor 204 can also track user 192 position, velocity and acceleration, either of a patient or a fitness user. Kreger at 9:9-40.

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	 FIG. 12 Kreger at Fig.12 **Continuing with FIG. 12, the biosensor signals are received by a smart phone 386 through dock connector 382, which is in communication with an electrical connector on smart phone 386 (obscured). The interface device dock 382 converts the human breath and human biopotential signals from sampling tube 388 and ECG leads 396 respectively into electrical signals suitable for communication to the smart phone 386 via one or more of the smart phone's electrical connectors such as a USB connector, a docking connector, or a headset connector. The electrical biosensor signals may be further processed by the smart phone 386 to produce displayed measurements such as BPM 414, respiratory rate 372, body temperature 418, and the like. As well, the biosensor signals may be plotted or otherwise displayed. For example, biosensor signals may be displayed by smart**

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	phone 386 such as ECG 420, ETCO 2 422, and the like. **Biosensor signals may also be received by one or more RF receivers in the dock 346 (not shown) and communicated to the smart phone 386 via wired electrical connectors. Interface device dock 382 may also include a connecting and supporting component 424 for communicating with electrical connectors and retaining the smart phone 386**. The connecting and supporting component 424 may have an attached neck or supporting component 426, which may be connected to base 428. The neck 426 may be articulated or otherwise provide a position for smart phone 386 such that the patient 390 is viewable for video monitoring or audible for audio monitoring 434. Base 428 may provide a secure mechanism for attaching the interface apparatus 380 to, for example, an incubator side 430. In addition, interface apparatus 380 may have an external source of AC or DC electrical power 432, which may provide electrical power to smart phone 386 through the electrical connectors in communication with connecting and supporting component 424. Further, **all signals received by the smart phone 386, such as ECG, ETCO2, body temperature, respiratory movement, video, and audio may be transmitted wirelessly by smart phone 386 or via a cable connected to the mobile for remote monitoring and storage.** Kreger at 11:35-12:4 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data,	Kreger discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. **Continuing to refer to FIG. 3, the microprocessor 74 receives one or more biosensor signals and may transform the data into a biosensor measurement such as BPM, or an otherwise useful signal such as a ECG signal suitable for medical diagnosis. The signals and measurements may be stored in memory 12 and may be used for plotting on display 94.** The signals and measurements may also

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and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	be used to provide information such as a BPM via speaker 98 or via a headset or earpiece (not shown). In addition, biosensor data may be produced by the mobile's internal accelerometer 70 if it is in communication with a human body, thereby serving as a biosensor that may be used to determine the patient's position, respiratory movement, and so forth. Kreger at 7:26-38 **The sensor data and measurements may be transmitted to remote medical personnel, internet servers, and others using WiFi transceiver 68, Bluetooth transceiver 72 or other RF transmitter such as for a cellular phone network. As well, the signals and measurements on the mobile 12 may be transferred via a cable connected to USB connector 28 c or docking connector 28 b to another computer storage device, over a computer network, to a personal computer, and so forth**. Kreger at 7:39-46 Smartphone 444 may also transmit the patient’s biosensor data and measurements using one or more internal RF transmitters, for example, over the mobile's data network, or as as modulated data, using frequency shift key (FSK), phase shift key (PSK) encoding or like modulation schemes over the mobile's voice network. In addition, the mobile 444 may transmit the data over a serial cable or an RF bluetooth channel, to a PC or other computing device, or via various other such wireless and wired interfaces, such as 3G, 4G, wired and wireless Ethernet and the like. Kreger at 12:19-19 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	

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12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kreger discloses or renders obvious the measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. Referring now to FIGS. 4 a and 4 b and also to FIG. 3, the microprocessor 74 may drive a display 94 to display the biosensor signals and measurements derived there from. For **example a movement sensor may be used to determine the speed 100 (strides per minute or SPM) or distance traveled 102 by an athlete during a workout. A cardiac sensor my provide an ECG signal 104 which can be used to calculate the heart rate 106. The speed 100 can be used separately, but preferably in tandem, to perform a cardiac stress exam and determine a patient's stress level. Speed 100 and/or heart rate 106 may also be used to monitor and control an effort level 110, 112 in a workout. As well, effort level 114 may be a target that is set for the workout**. Goals may be set and measurements may be displayed on, for example, a workout timer 112, which may show elapsed or remaining time and may have controls to set workout time. Moreover, other measurements such as Calories 116 may be displayed as “Calories elapsed” or “Calories remaining until goal”. Similarly for elapsed or remaining distance 102, a distance goal can be set, for example, in strides, miles, or kilometers. As well, for effort where an actual effort level 122 and a target effort level 120 can be shown graphically and the user may choose a certain effort profile or course such as Hill 124. Kreger at 7:47-8:2 Referring to FIGS. 17 and 18, **to determine SPO2 the LEDs510, 512 may be turned on alternately and without overlapping with power control unit526 and LED control lines528, 530 as shown by voltage plots529, 531 respectively. The information containing light520, 522 has separate contributions shown in plots523, 525. The alternating lights520, 522 are received and combined (multiplexed) by a single receiver524 as shown in plot526. Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components523, 525. The signals529, 531, and 533, or information derived therefrom may be supplied to the mobile device506 to demultiplex the pulse oximeter data as well as other sensor data** (see detailed description of FIG. 19 below).

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	Kreger at 13:51-64 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Kreger discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. Continuing with FIG. 1, the biosensor is shown as a pulse oximeter 14 in communication with finger 16. **The pulse oximeter may provide a pulse signal to calculate BPM, a SPO2 reading, or a diagnostic cardiac waveform. The pulse oximeter 14 may be retained against the base of finger 16 using a mounting device that may be worn on the finger or hand, shown as gauntlet 18.** Alternatively, the pulse oximeter may be worn on the fingertip, ear, forehead, or nasal septum using various mounting devices such as rings, clips, elastic straps, and adhesive pads. Kreger at 5:54-63 Referring now to FIGS. 4 a and 4 b and also to FIG. 3, the microprocessor 74 may drive a display 94 to display the biosensor signals and measurements derived there from. **For example a movement sensor may be used to determine the speed 100 (strides per minute or SPM) or distance traveled 102 by an athlete during a workout. A cardiac sensor my provide an ECG signal 104 which can be used to calculate the heart rate 106. The speed 100 can be used separately, but preferably in tandem, to perform a cardiac stress exam and determine a patient's stress level. Speed 100 and/or heart rate 106 may also be used to monitor and control an effort level 110, 112 in a workout. As well, effort level 114 may be a target that is set for the workout. Goals may be set and measurements may be displayed on, for example, a workout timer 112, which may show elapsed or remaining time and may have controls to set workout time. Moreover, other measurements such as Calories 116 may**

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	be displayed as “Calories elapsed” or “Calories remaining until goal”. Similarly for elapsed or remaining distance 102, a distance goal can be set, for example, in strides, miles, or kilometers. As well, for effort where an actual effort level 122 and a target effort level 120 can be shown graphically and the user may choose a certain effort profile or course such as Hill 124. Kreger at 7:47-8:2. Referring to FIGS. 17 and 18, to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown in plots 523, 525. **The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526. Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525. The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506 to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below).** Kreger at 13:51-64 Still referring to FIGS. 17 and 18, the interface device 502 may receive pulse oximeter and other sensors signals on conductors 536 and perform various transformations on the signals. For example, high frequency noise may be reduced with high pass filter 538, DC offsets and baseline wander can may be reduced with a low pass filter 440, **These filters may be instrumental in creating a signal which is usable for examples as a diagnostic display, an SPO2 calculation, a BPM calculation, and so forth. Internal mobile device filters, for example such as an anti-aliasing filter for recording inputs or a CODEC filter may be used.** Alternatively, internal filters can be reconfigured or disabled to allow, for example, the reception of lower frequency signals by the mobile 12 CODEC 76 or AtoD converter 78. Kreger at 14:4-17. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Kreger discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. Thus, it is **another object to provide compatible signals to the mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise** and drift, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth. Kreger at 3:16-23 **The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150.** The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Turning now to FIG. 13 a, **a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human**

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	tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47 Turning now to FIG. 15, **a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. **Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth**. Kreger at 13:4-29 Thus, it is another object to provide compatible signals to the **mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise and drif**t, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth.

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	Kreger at 3:17-23 The interface device 20 may also provide a sensors interface circuit 42 which receives biosensor signals on input conductor 24 and transforms the signals to output electrical signals 43 that are output on electrical connector 28. **The interface circuit provides output electrical signals 43 signals that are electrically compatible, for example, with respect to impedance, voltage amplitude, noise levels**, and so forth such that the signals can be received by the mobile's processor via connector 24. Kreger at 6:22-30 Still referring to FIGS. 17 and 18, **the interface device 502 may receive pulse oximeter and other sensors signals on conductors 536 and perform various transformations on the signals. For example, high frequency noise may be reduced with high pass filter538, DC offsets and baseline wander can may be reduced with a low pass filter 440, These filters may be instrumental in creating a signal which is usable for examples as a diagnostic display, an SPO2 calculation, a BPM calculation, and so forth**. Internal mobile device filters, for example such as an anti-aliasing filter for recording inputs or a CODEC filter may be used. Alternatively, internal filters can be reconfigured or disabled to allow, for example, the reception of lower frequency signals by the mobile 12 CODEC 76 or AtoD converter 78. Kreger at 14:4-17 Still referring to FIG. 19, the interface device 552 may receive pulse oximeter, other sensors signals, and synchronizing signals on conductors 567, 568 and perform various transformations on the signals**. For example, high frequency noise, DC offsets and baseline wander may be reduced with a band pass filter570. In addition, proper matching of the electrical characteristics of mobile's electrical connector may provided by matching stage 572, for example, as provided by matching stage 542 above.** Kreger at 14:49-57

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	The photo plethysmograph output signal and temperature sensor signal may be communicated from sensors assembly 587 by separate (i.e. parallel) conductors 588, 590 to interface device 582. High frequency noise, DC offsets and baseline wander may be reduced with anti-alias filters592, 593. The filtered signals are received by the serial AtoD converter 594, which converts them to digital values that are serialized for transmission to serial electrical connector 588 on mobile 586. Kreger at 14:65-15:5 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Kreger discloses or renders obvious the measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. Thus, it is **another object to provide compatible signals to the mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise** and drift, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth. Kreger at 3:16-23 **The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to**

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	emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Turning now to FIG. 13 a, **a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47 Turning now to FIG. 15, **a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and

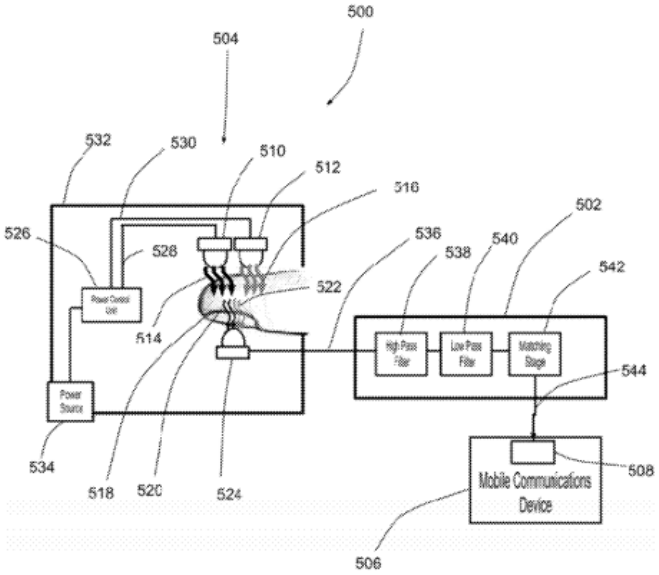
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	temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. **Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth**. Kreger at 13:4-29 Thus, it is another object to provide compatible signals to the **mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise and drif**t, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth. Kreger at 3:17-23 The interface device 20 may also provide a sensors interface circuit 42 which receives biosensor signals on input conductor 24 and transforms the signals to output electrical signals 43 that are output on electrical connector 28. **The interface circuit provides output electrical signals 43 signals that are electrically compatible, for example, with respect to impedance, voltage amplitude, noise levels**, and so forth such that the signals can be received by the mobile's processor via connector 24. Kreger at 6:22-30 Still referring to FIGS. 17 and 18, **the interface device 502 may receive pulse oximeter and other sensors signals on conductors 536 and perform various transformations on the signals. For example, high frequency noise may be reduced with high pass filter538, DC offsets and baseline wander can may be reduced with a low pass filter 440, These filters may be instrumental in creating a signal which is usable for examples as a diagnostic display, an SPO2 calculation, a BPM calculation, and so forth**. Internal mobile device filters, for example such as an anti-aliasing filter for recording inputs or a CODEC filter may be used. Alternatively, internal filters can be reconfigured or disabled to allow, for example, the reception of lower frequency signals by the mobile 12 CODEC 76 or AtoD converter 78.

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	Kreger at 14:4-17 Still referring to FIG. 19, the interface device 552 may receive pulse oximeter, other sensors signals, and synchronizing signals on conductors 567, 568 and perform various transformations on the signals**. For example, high frequency noise, DC offsets and baseline wander may be reduced with a band pass filter570. In addition, proper matching of the electrical characteristics of mobile's electrical connector may provided by matching stage 572, for example, as provided by matching stage 542 above.** Kreger at 14:49-57 **The photo plethysmograph output signal and temperature sensor signal may be communicated from sensors assembly 587 by separate (i.e. parallel) conductors 588, 590 to interface device 582. High frequency noise, DC offsets and baseline wander may be reduced with anti-alias filters592, 593.** The filtered signals are received by the serial AtoD converter 594, which converts them to digital values that are serialized for transmission to serial electrical connector 588 on mobile 586. Kreger at 14:65-15:5 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of:	Kreger discloses or renders obvious the measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.

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light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	*See* claim 11 above. Referring to FIGS. 1 and 2, the biosensor 14 may be in communication with the interface device 20 via cable 22. The cable may contain one or more conductors 24, 26**. The cable 22 may transmit power to the pulse oximeter 14 via conductor 26, or may transmit biosensor signals, such as the two absorption light signals from the pulse oximeter 14, via conductor 24.** Kreger at 5:64-6:3 The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27**. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown).** Kreger at 8:9-25 Turning now to FIG. 13 a, a cross section of photo plethysmograph 450 taken along axes 13 a is shown. **The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455**, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo

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	transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:5-28. Turning now to FIG. 15, a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, **the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal.** The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth. Kreger at 13:4-29.

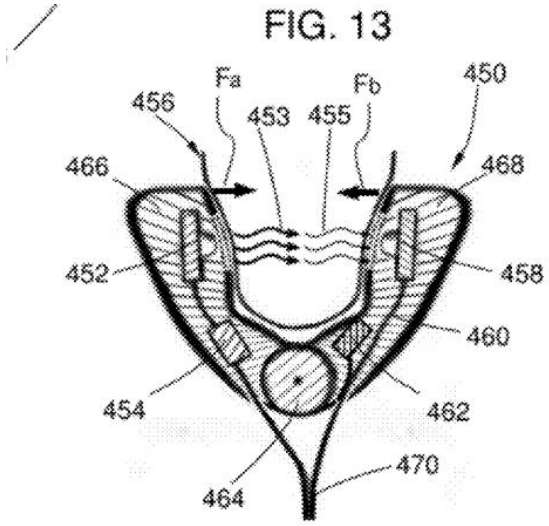
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	 FIG. 17 Kreger at Fig.17 Continuing with FIG. 17, **the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2.** The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502. Kreger at 13:36-50

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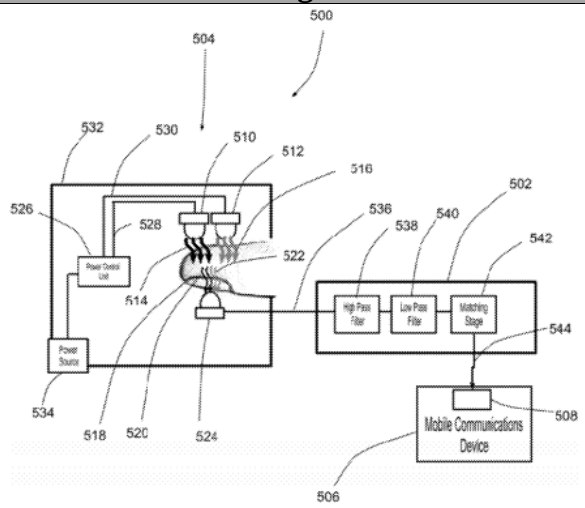
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	Referring to FIGS. 17 and 18, **to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown in plots 523, 525. The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526.** Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525. The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506 to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below). Kreger at 13:51-64 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Kreger discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 11 above. Turning now to FIG. 13 a, a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452**. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy**

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	from the photons of the light signal 455 into a corresponding electrical signal. In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47  FIG.13a Kreger at fig. 13a. The PPG 450 may releaseably attach to the user's earlobe 456 by using a biasing element 464 that provides forces Fa and Fb which grip earlobe 456 between opposing elements 466, 468. Elements 466, 468 may also house IR LED 452, power control unit 454, l**ight receiving device 458, motion/temperature sensor 462, and the like**. Additionally, PPG 450 is connected via conductors 470 to interface device 442, which may transmit one or more sensor signals and power. Kreger at 12:48-55. Turning now to FIG. 15, a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light

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	emitting element such IR LED 492. **A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491.** The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth. Kreger at 13:4-29. Continuing with FIG. 17, **the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502.** Kreger at 13:36-50.

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	 FIG. 17 Kreger at fig. 17. In one aspect of another embodiment (not shown), **the biosensor interface apparatus further includes at least on least one receiver capable of receiving a wireless biosensor signal.** The interface apparatus acts as an adapter for the wireless biosensor to utilize the capabilities of the mobile's electrical connectors. Importantly, wireless RF biosensors may need access to the mobile via its electrical connector, for example, with an iPhone® to avoid licensing issues. Kreger at 16:6-13. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

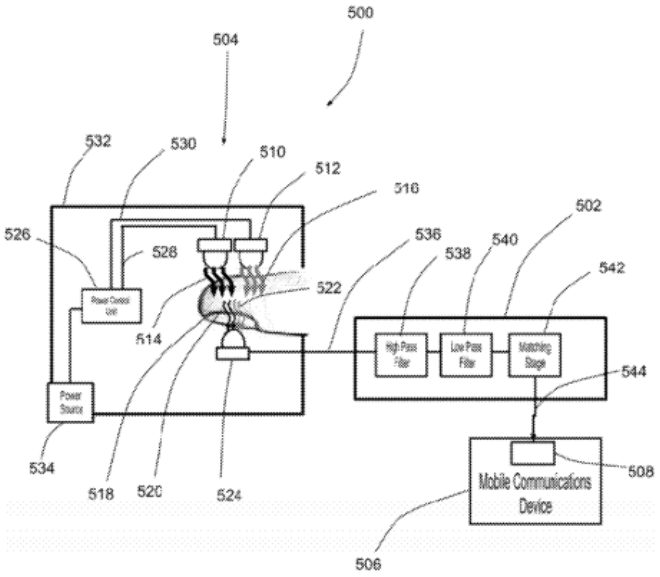
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Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Kreger discloses or renders obvious the measurement system of claim 15, wherein the first arc and the second arc are concentric. *See* claim 15 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kreger discloses or renders obvious a wearable device for use with a smart phone or tablet, the wearable device. *See* 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	Kreger discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* 11[a].

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Kreger discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths. Referring to FIGS. 1 and 2, the biosensor 14 may be in communication with the interface device 20 via cable 22. The cable may contain one or more conductors 24, 26**. The cable 22 may transmit power to the pulse oximeter 14 via conductor 26, or may transmit biosensor signals, such as the two absorption light signals from the pulse oximeter 14, via conductor 24.** Kreger at 5:64-6:3 The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27**. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown).** Kreger at 8:9-25 Turning now to FIG. 13 a, a cross section of photo plethysmograph 450 taken along axes 13 a is shown. **The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453**

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	when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:30-47 Turning now to FIG. 15, a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, **the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal.** The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth. Kreger at 13:4-29 **The pulse oximeter output signal 558 may be multiplexed with accelerometer signal 560 by multiplexer 562. Recall that the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526.** Similarly, power control unit 564 may supply a signal to the

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	multiplexor 562 to time multiplex the accelerometer and pulse oximeter signals 566 into a combined signal 567. Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals combined in pulse ox output 558 and the accelerometer output 569 into their three individual components (and perhaps more for additional accelerometer outputs). The power control unit 564 may provide a synchronizing signal such as 568 to the mobile device 556 to demultiplex the pulse oximeter data and accelerometer data. The synchronizing signal 568 may be further combined with the sensor data by another multiplexer 576. Kreger at 14:33-48  FIG. 17 Kreger at Fig.17 Continuing with FIG. 17, **the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940**

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	nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502. Kreger at 13:36-50 Referring to FIGS. 17 and 18, **to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown in plots 523, 525. The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526.** Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525. The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506 to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below). Kreger at 13:51-64. Referring now to FIGS. 21-23, an embodiment of the interface apparatus 600 may comprise an interface device 602 that has a frequency multiplexer 601. The interface device may connect multiple signals such as pulse oximeter signal 604, body temperature signal 606, microphone signal 608, which are combined by multiplexer 601 into a signal that may be transmitted to one or more mobile electrical audio inputs 612. The interface device 602 may also provide outputs for a headsets loudspeakers 614 allowing the headset to connect to the audio connector loudspeaker outputs 616, that may otherwise be utilized by interface device 602. Similarly, the interface device 602 microphone input 608, that may otherwise be utilized by interface device 602. The frequency multiplexer 601 may combine the signals 604, 606, 608 in a number of ways. For example, the microphone input 608 may be transformed by notch filter 618 to remove a portion of the signal between frequencies fn1 and fn2 as shown by frequency profile of notch filter output signal 620. **The sensor inputs 604, 606 may be transformed by low pass filters 622, 624**

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	and frequency shifted by modulators 626, 628 such that they are non-overlapping and within the notch 620 of notch filter 618 as shown by frequency plots of signals 630, 632. The filtered microphone signal 620 and the filtered and shifted sensors 630, 632 are combined by summer 634 to form the combination signal 636 which is received by a mobile device's audio input having bandwidth from f1 to f h 638. Alternatively, the data may be modulated and/or multiplexed by any number of modulation schemes such as frequency shift key (FSK), phase shift key (PSK) encoding or the like. Kreger at 15:6-34. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Kreger discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to:	Kreger disloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into

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capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;	a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue; *See* 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Kreger discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Kreger discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Kreger discloses or renders obvious increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[a], 11[b], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Kreger discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless	Kreger discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* 11[k], 19[pre].

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receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link.	Kreger discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Kreger discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claims 13, 19 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Kreger discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claims 15, 20 above One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Kreger discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claims 16, 21 above One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D18

U.S. Pat. No. 10,874,304 in view of US Patent Publication No. 2006/0184040 to Kurtis Keller at el. ("Keller")

As described in detail below, Keller (individually or collectively) anticipates and/or renders obvious claim 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D17 and D19, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. . This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Keller. The cited portions of Keller are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Keller. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Keller "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Keller does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Keller (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Keller anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 11	
11[pre] A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Keller discloses or renders obvious a measurement system. An apparatus for optically analyzing a substrate. The apparatus includes: (a) a light source for directing light onto the substrate; (b) optics for creating an optical path from light reflected from the substrate; and (c) a multiple wavelength imaging optical subsystem positioned in the optical path. The multiple wavelength imaging optical subsystem includes: (i) one or more filters which are capable of one or both of: (1) being alternatively or sequentially interposed in the optical path to extract one or more of wavelengths or wavelength bands of interest; or (2) having their wavelength selectivity adjusted to extract one or more wavelengths or wavelength bands of interest; and (ii) one or more imaging devices positioned to image the extracted wavelengths or wavelength bands of interest from the one or more filters; (d) an imaging device positioned in the optical path. Also a method is included, making use of the apparatus for analysis of a substrate. Keller at [Abstract] The present invention relates to an apparatus, system and method for optically analyzing a substrate. The invention also relates to a multiple wavelength-imaging optical subsystem (MWIOS) for use in an apparatus of the invention. Further, the invention relates to optical scopes, such as diagnostic scopes, which include the MWIOS, and to optical scope systems which may also include light emitting, collecting, and analysis capability for analysis and/or diagnosis of tissue abnormalities, particularly human tissue abnormalities. The invention also relates to methods of using the apparatus, system and method of the invention in the analysis of a substrate, such as a tissue substrate, particularly a human tissue substrate, and for use in analysis and/or diagnosis of tissue abnormalities, particularly human tissue abnormalities. Keller at [0002]. The invention includes an apparatus for optically analyzing a substrate. The apparatus generally includes a light source for directing light onto the substrate; optics for creating an optical path from light reflected from the substrate; a multiple wavelength imaging optical subsystem (MWIOS) positioned in the optical path; and an imaging device positioned in the optical path. The MWIOS generally includes one or more

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	filters, which can be alternatively or sequentially interposed in the optical path to extract wavelengths or wavelength bands of interest and/or which may have their wavelength selectivity adjusted to extract one or more wavelengths or wavelength bands of interest; and one or more imaging devices positioned to image the extracted wavelengths or wavelength bands of interest from the one or more filters. The apparatus of the invention may also include a means for transmitting image data from the one or more imaging devices, which means can be electronically coupled to a system to permit transmission of data from the imaging device to the system. Keller at [0007]. In one aspect of the invention the processor is programmed (or software is stored on a storage medium) to analyze the substrate based on information from the images about the scattering, absorbing and other such optical properties of the substrate by measuring the change in the intensity of reflected light over a predetermined spectral range. For example, in one embodiment, a change in the intensity of reflected light over a predetermined spectral range that is outside the range of the scattering, absorbing and other such optical properties of normal tissue represents a potential abnormality, or a potential member of a class of abnormalities. As another example, a change in the intensity of reflected light over a predetermined spectral range that is outside the range of the scattering, absorbing and other such optical properties for normal tissue and inside the range of the scattering and absorbing and other such optical properties of a tissue abnormality or class of tissue abnormalities represents a potential abnormality and/or a potential member of a class of abnormalities. Keller at [0026]. Referring to FIG. 1, the invention provides an optical scope system 100, having an optical scope 100 a and system components 100 b, for analysis of a substrate 101. The optical scope system 100 generally includes some or all of the following components: Optical Scope 100 a includes: Target Substrate 101 to be analyzed Light Source 102 Entry Lens Set 103 Wide-Wavelength Band Distortion Correction 104 Beam Splitter-Mirror Configuration 105 (optionally with Enhanced Operation Enabler/Disabler)

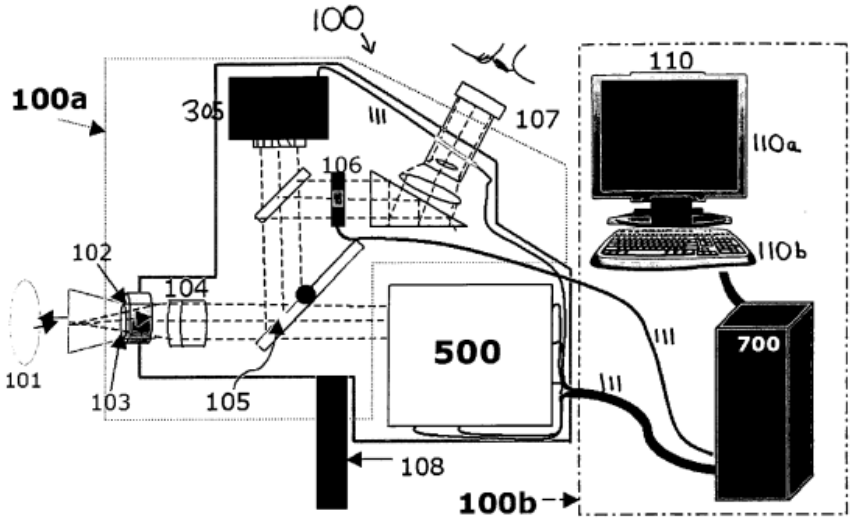
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	Overlain Eyepiece Diagnostic Display 106 Eyepiece 107 Lockable Rolling Stand 108 Electronic Coupling 111 Imaging Device 305 (see also, FIG. 3) Multiple-Wavelength Imaging Optical Subsystem 500 (see also, FIG. 5) System Components 100 b include: Software-Driven Console User Interface 110 Output Device 110 a Input Device 110 b Electronic Coupling 111 Computational System for Data Analysis 700 (see also, FIG. 7) Distance Indexing Mechanism (Optional). Keller at [0066]

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Figure 1. Overall System Schematic Diagram



Number	Description
100	**Diagnostic Optical Scope System**
100a	**Optical Scope**
- 101	Target Substrate
- 102	Light Source
- 103	Entry Lens Set
- 104	Wide-Wavelength Band Distortion Correction
- 105	Beam Splitter/Mirror Configuration
- 106	Overlain Eyepiece Diagnostic Display
- 107	Eyepiece
- 108	Lockable Rolling Stand
- 111	Electronic Coupling
- 305	Imaging Device
- 500	Multiple-Wavelength Imaging Optical Subsystem
100b	**System Components**
- 110	Software-Driven Console User Interface
- 110a	Output Device
- 110b	Input Device
- 111	Electronic Coupling
- 700	Computational System

Keller a Fig.1

The invention provides methods for using the apparatus 100 a and system 100 of the invention to analyze optically a substrate 101. The methods of the invention generally involve emitting light upon a substrate 101, collecting light reflected from the substrate 101, and recording and analyzing the light to provide information about the optical characteristics of the substrate 101.

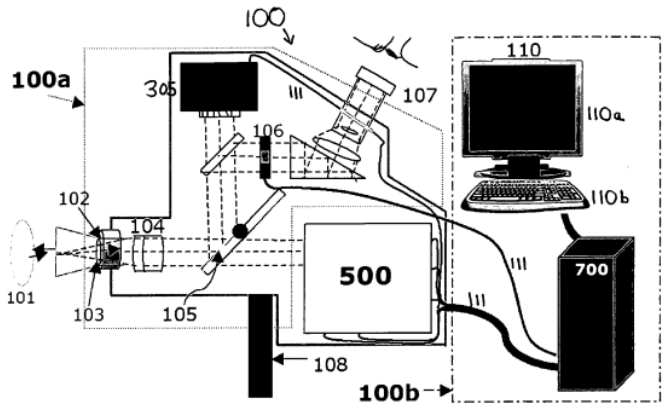
’304 Patent	Keller
	Keller at [0211] The absorption characteristics can be varied by adding small amounts of India Ink to the phantoms. India Ink in concentrations of 1 mL/L will produce the absorption coefficients needed to simulate tissues at the chosen wavelengths. The phantoms can be prepared to simulate the range of expected scattering and absorption properties in 5% intervals relative to the average measurements listed by Hornung [HORN99] up to a 50% variation. As previously stated, the system will observe and record each of these combinations; the spectral variation of the absorbers (measured as unusual combinations of intensity ratios) will enable the system to distinguish between increased absorption and increased scattering. Keller at [0295] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a] a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Keller discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths. The invention includes an apparatus for optically analyzing a substrate. The apparatus generally includes a light source for directing light onto the substrate; optics for creating an optical path from light reflected from the substrate; a multiple wavelength imaging optical subsystem (MWIOS) positioned in the optical path; and an imaging device positioned in the optical path. The MWIOS generally includes one or more filters, which can be alternatively or sequentially interposed in the optical path to extract wavelengths or wavelength bands of interest and/or which may have their wavelength selectivity adjusted to extract one or more wavelengths or wavelength bands of interest; and one or more imaging devices positioned to image the extracted wavelengths or wavelength bands of interest from the one or more filters. The

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	apparatus of the invention may also include a means for transmitting image data from the one or more imaging devices, which means can be electronically coupled to a system to permit transmission of data from the imaging device to the system. Keller at [0007] As noted above, the apparatus of the invention includes a light source for illuminating a substrate. The light source may, for example, emit wavelengths comprising wideband white light, including all or portions of the visible, near-infrared and infrared ranges. The light source may, for example, include a physically continuous light source, a ring light, and/or one or more point light sources. The light source may be filtered to remove wavelengths not of interest. For example, wavelengths that can cause image corruption and/or undesirable thermal effects in the images and/or patient discomfort may be removed. Further, the light source may be supplemented with additional light in one or more wavelengths of interest. In certain embodiments, the light source does not include or consist of a xenon light source. Further, in some embodiments, the light source does not include or consist of a UV light source. In some embodiments, the light source includes neither a xenon light source nor a UV light source. The system analyzes wavelengths of interest, which are in some embodiments selected from wavelengths within the visible, near-infrared and infrared bands of light. In some embodiments, the light source emits light comprising one or more wavelengths selected from the group consisting of visible, near-infrared and infrared bands of light. The analyzed wavelengths of interest may in some embodiments include individual wavelengths, combinations of individual wavelengths, or wavelength bands from the visible, near-infrared and infrared ranges. Keller at [0013] The invention provides an apparatus, system and method for optically analyzing a substrate. The apparatus, system and method of the invention are useful for recording and analyzing the optical characteristics of the substrate. The substrate is suitably a tissue substrate, for instance, human tissue and/or animal tissue, and the analysis may relate to optical characteristics useful for identifying tissue abnormalities, such as pre-cancerous and cancerous lesions, glucose abnormalities and burn injuries. However, it will be appreciated that the optical scope will be useful in the analysis of other substrates as well, including for example, in vitro tissue samples, manufactured materials, plastics, metals, soils, and other materials.

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	Keller at [0060] The optical scope 10 a of the invention may include a light source 102. The light source 102 may be integral with or separate from the optical scope 100 a. The light source 102 functions to emit light, e.g., wideband white light, encompassing all wavelengths of interest. Wavelengths of interest may, for example, include wavelengths within any of the ultra-violet, visible, near-infrared or infrared ranges. The light source 102 emits light onto the surface of the substrate 101 to be examined. This substrate 101, e.g., a tissue substrate, may be illuminated by one or more continuous and/or point light sources. The continuous or point light source(s) may be oriented in any of a variety of patterns, e.g., circular, semicircular or other semi-parallel pattern. These sources can, for example, be centered around the scope's optical path; they can be oriented off-axis; or they may share the optical path of the scope itself. Keller at [0087]

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	Figure 1. Overall System Schematic Diagram  Keller at Fig. 1 Furthermore, light of specific bands can be injected into or combined with the light from the main light source (white wideband light, for example), to provide additional intensity for some narrowband wavelengths. For example, if in an embodiment of the invention, the wavelength 1000 nm is chosen as a wavelength of interest, and the light source selected for use in said embodiment does not provide adequate intensity thereof, then one or more 1000-nm light-emitting diodes (LEDs) may be used to increase to provide additional intensity. This intensity supplementation can be induced, for example, by filtered wideband light, LEDs, lasers or other light sources. Keller at [0089].

Number	Description
100	**Diagnostic Optical Scope System**
100a	**Optical Scope**
- 101	Target Substrate
- 102	Light Source
-103	Entry Lens Set
- 104	Wide-Wavelength Band Distortion Correction
- 105	Beam Splitter/Mirror Configuration
- 106	Overlain Eyepiece Diagnostic Display
- 107	Eyepiece
- 108	Lockable Rolling Stand
- 111	Electronic Coupling
- 305	Imaging Device
- 500	Multiple-Wavelength Imaging Optical Subsystem
100b	**System Components**
- 110	Software-Driven Console User Interface
- 110a	Output Device
- 110b	Input Device
- 111	Electronic Coupling
- 700	Computational System

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	The light source can be comprised of a single, continuous light source, or several point light sources. In some embodiments where it is desirable for the intensities of certain wavelengths to be increased, the light source may be supplemented with additional single- or multiple-wavelength light sources, such as LEDs. Keller at [0104]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b] the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Keller discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. An apparatus for optically analyzing a substrate. The apparatus includes: (a) a light source for directing light onto the substrate; (b) optics for creating an optical path from light reflected from the substrate; and (c) a multiple wavelength imaging optical subsystem positioned in the optical path. The multiple wavelength imaging optical subsystem includes: (i) one or more filters which are capable of one or both of: (1) being alternatively or sequentially interposed in the optical path to extract one or more of wavelengths or wavelength bands of interest; or (2) having their wavelength selectivity adjusted to extract one or more wavelengths or wavelength bands of interest; and (ii) one or more imaging devices positioned to image the extracted wavelengths or wavelength bands of interest from the one or more filters; (d) an imaging device positioned in the optical path. Also a method is included, making use of the apparatus for analysis of a substrate. Keller at [Abstract]

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	In one aspect of the invention the processor is programmed (or software is stored on a storage medium) to analyze the substrate based on information from the images about the scattering, absorbing and other such optical properties of the substrate by measuring the change in the intensity of reflected light over a predetermined spectral range. For example, in one embodiment, a change in the intensity of reflected light over a predetermined spectral range that is outside the range of the scattering, absorbing and other such optical properties of normal tissue represents a potential abnormality, or a potential member of a class of abnormalities. As another example, a change in the intensity of reflected light over a predetermined spectral range that is outside the range of the scattering, absorbing and other such optical properties for normal tissue and inside the range of the scattering and absorbing and other such optical properties of a tissue abnormality or class of tissue abnormalities represents a potential abnormality and/or a potential member of a class of abnormalities. Keller at [0026] In a preferred embodiment, the system includes multiple imaging devices and one or more utilities programmed to geometrically register the geometry of the substrate to the pixels of the multiple imaging devices and/or normalize intensity values across multiple images of the substrate from the multiple imaging devices. In certain embodiments, the normalization is accomplished automatically. The normalization may be based on an area of said imagery selected by input from a user. The system may include a utility programmed to extract subsections of said substrate wherein one or both of excessive light intensity or insufficient light intensity prevents imaging of said substrate with sufficient quality to permit the desired analysis. For example, the utility may be programmed to omit such subsections from diagnostic processing and/or to inform the user that said subsections will require re-imaging during one or more of adjusted lighting, filtering, or positioning circumstances. The system may include a utility programmed to identify spectral attributes in image sub-areas characteristic to a tissue abnormality or not characteristic of normal tissue and provide output to a user indicating the location of such image sub-areas. The analysis and output may include classification of the tissue abnormality. Keller at [0028] Normalization may be achieved through a variety of means. In one such method, a uniform flat target is imaged by each imaging device 504 and filter 502 combination and under varying illumination intensities and exposures. From analysis of this set of flat-field calibration imagery, it is possible to calculate per

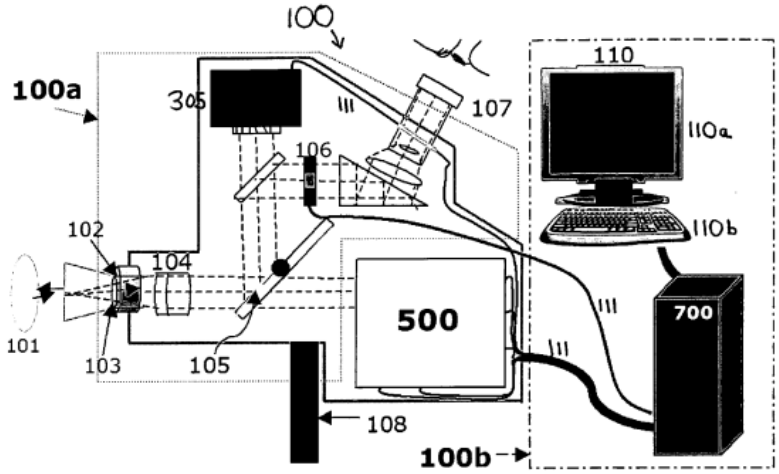
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	pixel (or per group of pixels to average out noise) normalization coefficients for each imaging device 504. This method of intensity normalization includes a subroutine to remove areas of the monochrome images that are either above or below set boundary levels of intensity. This is done so that areas of the image which receive levels of light too high or too low for proper image processing are removed before the computation across the image is done. Such areas could be highlighted in a different way from the manner in which suspected abnormalities are highlighted (as described below), distinguishing them for the user. If the user so chose, he/she could position the tissue in such a way as to provide more or less light to the unprocessed areas. Keller at [0183] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c] the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Keller discloses or renders obvious the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. The invention provides an apparatus, system and method for optically analyzing a substrate. The apparatus, system and method of the invention are useful for recording and analyzing the optical characteristics of the substrate. The substrate is suitably a tissue substrate, for instance, human tissue and/or animal tissue, and the analysis may relate to optical characteristics useful for identifying tissue abnormalities, such as pre-cancerous and cancerous lesions, glucose abnormalities and burn injuries. However, it will be appreciated that the optical scope will be useful in the analysis of other substrates as well, including for example, in vitro tissue samples, manufactured materials, plastics, metals, soils, and other materials. Keller at [0060]

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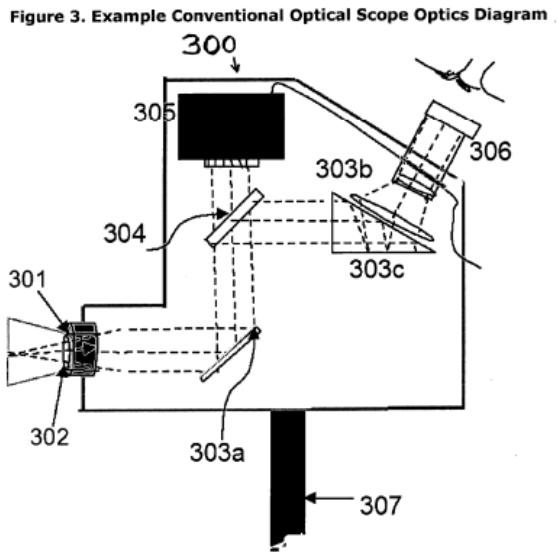
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	The optical scope 10 a of the invention may include a light source 102. The light source 102 may be integral with or separate from the optical scope 100 a. The light source 102 functions to emit light, e.g., wideband white light, encompassing all wavelengths of interest. Wavelengths of interest may, for example, include wavelengths within any of the ultra-violet, visible, near-infrared or infrared ranges. The light source 102 emits light onto the surface of the substrate 101 to be examined. This substrate 101, e.g., a tissue substrate, may be illuminated by one or more continuous and/or point light sources. The continuous or point light source(s) may be oriented in any of a variety of patterns, e.g., circular, semicircular or other semi-parallel pattern. These sources can, for example, be centered around the scope's optical path; they can be oriented off-axis; or they may share the optical path of the scope itself. Keller at [0087]

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	Figure 1. Overall System Schematic Diagram  **Number** / **Description** **100** Diagnostic Optical Scope System **100a** Optical Scope - 101 Target Substrate - 102 Light Source - 103 Entry Lens Set - 104 Wide-Wavelength Band Distortion Correction - 105 Beam Splitter/Mirror Configuration - 106 Overlain Eyepiece Diagnostic Display - 107 Eyepiece - 108 Lockable Rolling Stand - 111 Electronic Coupling - 305 Imaging Device - 500 Multiple-Wavelength Imaging Optical Subsystem **100b** System Components - 110 Software-Driven Console User Interface - 110a Output Device - 110b Input Device - 111 Electronic Coupling - 700 Computational System Keller at Fig. 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d] the wearable measurement device further comprising a receiver configured to:	Keller discloses or renders obvious the wearable measurement device further comprising a receiver. Referring to FIG. 1, the invention provides an optical scope system 100, having an optical scope 100 a and system components 100 b, for analysis of a substrate 101. The optical scope system 100 generally includes some or all of the following components: Optical Scope 100 a includes: Target Substrate 101 to be analyzed Light Source 102 Entry Lens Set 103 Wide-Wavelength Band Distortion Correction 104 Beam Splitter-Mirror Configuration 105 (optionally with Enhanced Operation Enabler/Disabler) Overlain Eyepiece Diagnostic Display 106 Eyepiece 107 Lockable Rolling Stand 108 Electronic Coupling 111 Imaging Device 305 (see also, FIG. 3) Multiple-Wavelength Imaging Optical Subsystem 500 (see also, FIG. 5) System Components 100 b include: Software-Driven Console User Interface 110 Output Device 110 a Input Device 110 b Electronic Coupling 111 Computational System for Data Analysis 700 (see also, FIG. 7) Distance Indexing Mechanism (Optional). Keller at [0066] The imaging device 305 may comprise a color video camera, such as an area camera, a line-scan camera, a focal plane array, or the like. For example, its technology may be based on charged-couple device (CCD), complimentary metal-oxide semiconductor (CMOS) or Indium-Gallium-Arsenide (InG aAs)

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	detectors. In the optical path, the imaging device 305 may, for example, follow the beam-splitter 304 and output its imagery to a user interface (e.g., the eyepiece 306 or user console). The resolution of the imaging device 305 may be, for example, greater than 300,000 pixels. Keller at [0109]  | Number	Description
300	Conventional Optical Scope
301	Light Source
302	Entry Lens Set
303	Magnification and/or Directive Optics/Lenses
304	Beam-splitter
305	Imaging Device
306	Eyepiece
307	Lockable Rolling Stand | Keller at Fig.3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are

’304 Patent	Keller
	incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e] receive and process at least a portion of the analysis output beam reflected or transmitted from the sample	Keller discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. In some embodiments, the system of the invention is programmed to analyze optical data from the images. The optical data may, for example, include optical properties, such as the scattering and/or absorbing properties of the substrate. The analysis can be made by measuring the change in the intensity of reflected light over a predetermined spectral range. In certain preferred embodiments, the substrate analyzed comprises tissue, for instance, human tissue or animal tissue, and the computer system is programmed to conduct analysis of the image data from the one or more imaging devices. Preferably the system is configured to image and to analyze a full-frame image of the tissue. For example, in one embodiment, the optical scope of the system is configured as a colposcope; the colposcope is configured to capture a full-frame image of the cervix; and the system is programmed to analyze the full-frame image. Also, for example, in some embodiments, the system is configured to capture a full-frame image of the cervix wherein the image comprises between 4,000 and 16,000,000 pixels. In other embodiments, the image comprises at least 19,000 pixels, 60,000, pixels, at least 100,000 pixels, at least 500,000 pixels, or at least 1,000,000 pixels. Keller at [0012]. One or more of the imaging devices may be selected for its capacity to image light from its corresponding filter. The imaging devices may, for example, image a set of one or more continuous or discrete wavelengths or wavelength bands from the visible and/or near-infrared (NIR) ranges. In a preferred embodiment, the MWIOS includes 2, 3, 4, 5, 6 or more filters ordered in a series, where each filter in the series (a) permits a pre-selected set of one or more continuous or discrete wavelengths or wavelength bands to pass through and into an optical path that is directed to and imaged by an imaging device, and (b) reflects light that does not pass through the filter to a next filter in the series; and (c) functions (a) and (b) are performed by all filters in the series in succession until a final filter, which reflects any remaining light to an absorbent substrate.

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’304 Patent	Keller
	Keller at [0015]. The imaging device 305 may comprise a color video camera, such as an area camera, a line-scan camera, a focal plane array, or the like. For example, its technology may be based on charged-couple device (CCD), complimentary metal-oxide semiconductor (CMOS) or Indium-Gallium-Arsenide (InG aAs) detectors. In the optical path, the imaging device 305 may, for example, follow the beam-splitter 304 and output its imagery to a user interface (e.g., the eyepiece 306 or user console). The resolution of the imaging device 305 may be, for example, greater than 300,000 pixels. Keller at [0109] In some embodiments, the back of the image display device 110 can be painted or otherwise coated with a light-absorbing coating, such as a flat-black coating, to absorb the light being directed to it by the beam splitter 304, and thereby to prevent corruption of the imaging device 305 image caused light from reflecting back to the beam splitter 304 and into the field of view of the imaging device 305. Keller at [0201] The invention provides methods for using the apparatus 100 a and system 100 of the invention to analyze optically a substrate 101. The methods of the invention generally involve emitting light upon a substrate 101, collecting light reflected from the substrate 101, and recording and analyzing the light to provide information about the optical characteristics of the substrate 101. Keller at [0211] The ensuing examples focus on the embodiment in which the substrate 101 is a tissue substrate (human tissue or animal tissue), and the analysis relates to optical characteristics useful for identifying tissue abnormalities, such as pre-cancerous and cancerous lesions, glucose abnormalities and burn injuries. However, it will be appreciated that the methods of the invention will be useful in the analysis of other substrates 101 as well, including for example, in vitro tissue samples; manufactured materials such as plastics and metals; soil or other materials. Keller at [0212]

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	Operation in Principle. The embodiment of the invention that detects tissue lesions operates in principle in the following way: certain wavelengths of light are selected for their known, distinct behaviors when interacting with healthy tissue and with tissue lesions; these wavelengths are extracted from light reflected off of the tissue and imaged; the wavelength-specific images are studied for the pre-determined characteristics associated with tissue lesions. Keller at [0214] For example, referring now to FIG. 2, a tissue sample is schematically illustrated at the bottom of the figure, and above the tissue sample, its spectral signature across several chosen wavelengths is presented. In the lowest wavelengths of this sample (i.e., those toward of the end of the “sampling wavelength” axis marked “visible”), the intensities for the samples relating to the lesion are much lower than those for healthy tissue. A demonstrated explanation for this is that the lower wavelengths tend to absorb into hemoglobin, which is present in greater quantities in lesions than in healthy tissue, so less light is reflected. Likewise, these intensities may become higher than the healthy samples as the wavelength increases; it has also been demonstrated that the higher wavelengths tend to scatter more in lesions, so more reflected light of these wavelengths may be received by a detector. Keller at [0215]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f] generate an output signal representing at least in part a non-invasive	Keller discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample.

’304 Patent	Keller
measurement on blood contained within the sample,	In a preferred embodiment, the system includes multiple imaging devices and one or more utilities programmed to geometrically register the geometry of the substrate to the pixels of the multiple imaging devices and/or normalize intensity values across multiple images of the substrate from the multiple imaging devices. In certain embodiments, the normalization is accomplished automatically. The normalization may be based on an area of said imagery selected by input from a user. The system may include a utility programmed to extract subsections of said substrate wherein one or both of excessive light intensity or insufficient light intensity prevents imaging of said substrate with sufficient quality to permit the desired analysis. For example, the utility may be programmed to omit such subsections from diagnostic processing and/or to inform the user that said subsections will require re-imaging during one or more of adjusted lighting, filtering, or positioning circumstances. The system may include a utility programmed to identify spectral attributes in image sub-areas characteristic to a tissue abnormality or not characteristic of normal tissue and provide output to a user indicating the location of such image sub-areas. The analysis and output may include classification of the tissue abnormality. Keller at [0028] For instance, the wavelength or wavelengths analyzed may be selected based on their facility for imaging the attributes of tissue lesions that differentiate the tissue lesions from healthy tissue. For example, lesions may display excessive angiogenesis, and may consequently contain significantly more hemoglobin than healthy tissue. Excessive angiogenesis may be assessed at wavelengths around the Soret band (420 nm), a very strong absorption band for the heme b protein that primarily constitutes hemoglobin. Other useful wavelengths include the near-infrared [HORN99, ALI04] and infrared [CHIR98] ranges. Keller at [0159] For example, referring now to FIG. 2, a tissue sample is schematically illustrated at the bottom of the figure, and above the tissue sample, its spectral signature across several chosen wavelengths is presented. In the lowest wavelengths of this sample (i.e., those toward of the end of the “sampling wavelength” axis marked “visible”), the intensities for the samples relating to the lesion are much lower than those for healthy tissue. A demonstrated explanation for this is that the lower wavelengths tend to absorb into hemoglobin, which is present in greater quantities in lesions than in healthy tissue, so less light is reflected. Likewise, these intensities may become higher than the healthy samples as the wavelength

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	increases; it has also been demonstrated that the higher wavelengths tend to scatter more in lesions, so more reflected light of these wavelengths may be received by a detector. Keller at [0215] In certain embodiments, after the images have been viewed and/or recorded, the system 100 immediately outputs information characterizing any lesion identified. Such information may, for example, include a map of the tissue analyzed identifying the specific location of any lesions identified. The information may also include diagnostic characterization information, such as information about the type of lesion identified or information about types of lesions ruled out by the analysis. Keller at [0234] The components of the phantoms can be chosen based on their own absorption and scattering coefficients; they can include one or more of: Intralipid™, a fat emulsion that mimics bulk tissue; polystyrene spheres, which serve to scatter light in a manner predicted by Mie theory; and hemoglobin, the component of blood that absorbs light in narrow bands; and India ink, which absorbs light over a broad spectral range. Keller at [0292] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g] synchronize to the light source,	Keller discloses or renders obvious the receiver configured to synchronize to the light source. In some embodiments, the light source 102 is band-filtered in order, for example, to reduce the impact of some heat-producing infrared wavelengths that are not of interest and thereby to improve patient

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	comfort during examination. The light source 102 may also or alternatively be notch-filtered to exclude unnecessary or undesirable wavelengths. For example, NIR and IR radiation can cause excessive amounts of heat, so the portions of those spectra that are not included in the wavelengths of interest may be notch-filtered from the light entering the system of the invention prior to entrance, so as to minimize the amount of heat to be dissipated. The light source 102 may also be pulsed or flashed, in order, for example, to synchronize with the imaging devices 305, 504 (see, FIGS. 3 and 5, respectively) of the invention. Keller at [0088] The invention provides methods for using the apparatus 100 a and system 100 of the invention to analyze optically a substrate 101. The methods of the invention generally involve emitting light upon a substrate 101, collecting light reflected from the substrate 101, and recording and analyzing the light to provide information about the optical characteristics of the substrate 101. Keller at [0211] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h] capture light while the semiconductor sources are off and convert the captured light into a first signal,	Keller discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i] capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Keller discloses or renders obvious capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. The optical scope 10 a of the invention may include a light source 102. The light source 102 may be integral with or separate from the optical scope 100 a. The light source 102 functions to emit light, e.g., wideband white light, encompassing all wavelengths of interest. Wavelengths of interest may, for example, include wavelengths within any of the ultra-violet, visible, near-infrared or infrared ranges. The light source 102 emits light onto the surface of the substrate 101 to be examined. This substrate 101, e.g., a tissue substrate, may be illuminated by one or more continuous and/or point light sources. The continuous or point light source(s) may be oriented in any of a variety of patterns, e.g., circular, semicircular or other semi-parallel pattern. These sources can, for example, be centered around the scope's optical path; they can be oriented off-axis; or they may share the optical path of the scope itself. Keller at [0087] The imaging device 305 may comprise a color video camera, such as an area camera, a line-scan camera, a focal plane array, or the like. For example, its technology may be based on charged-couple device (CCD), complimentary metal-oxide semiconductor (CMOS) or Indium-Gallium-Arsenide (InG aAs) detectors. In the optical path, the imaging device 305 may, for example, follow the beam-splitter 304 and output its imagery to a user interface (e.g., the eyepiece 306 or user console). The resolution of the imaging device 305 may be, for example, greater than 300,000 pixels. Keller at [0109] The invention provides methods for using the apparatus 100 a and system 100 of the invention to analyze optically a substrate 101. The methods of the invention generally involve emitting light upon a substrate 101, collecting light reflected from the substrate 101, and recording and analyzing the light to provide information about the optical characteristics of the substrate 101.

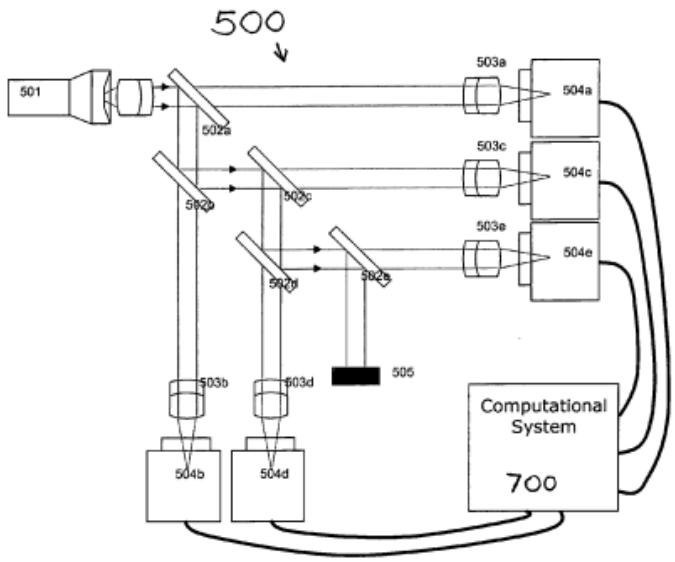
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	Keller at [0211] For example, referring now to FIG. 2, a tissue sample is schematically illustrated at the bottom of the figure, and above the tissue sample, its spectral signature across several chosen wavelengths is presented. In the lowest wavelengths of this sample (i.e., those toward of the end of the “sampling wavelength” axis marked “visible”), the intensities for the samples relating to the lesion are much lower than those for healthy tissue. A demonstrated explanation for this is that the lower wavelengths tend to absorb into hemoglobin, which is present in greater quantities in lesions than in healthy tissue, so less light is reflected. Likewise, these intensities may become higher than the healthy samples as the wavelength increases; it has also been demonstrated that the higher wavelengths tend to scatter more in lesions, so more reflected light of these wavelengths may be received by a detector. Keller at [0215] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[j] wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Keller discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. As noted above, the apparatus of the invention includes a light source for illuminating a substrate. The light source may, for example, emit wavelengths comprising wideband white light, including all or portions of the visible, near-infrared and infrared ranges. The light source may, for example, include a physically continuous light source, a ring light, and/or one or more point light sources. The light source may be filtered to remove wavelengths not of interest. For example, wavelengths that can cause image corruption and/or undesirable thermal effects in the images and/or patient discomfort may be removed. Further, the light source may be supplemented with additional light in one or more wavelengths of interest. In certain embodiments, the light source does not include or consist of a xenon light source.

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	Further, in some embodiments, the light source does not include or consist of a UV light source. In some embodiments, the light source includes neither a xenon light source nor a UV light source. The system analyzes wavelengths of interest, which are in some embodiments selected from wavelengths within the visible, near-infrared and infrared bands of light. In some embodiments, the light source emits light comprising one or more wavelengths selected from the group consisting of visible, near-infrared and infrared bands of light. The analyzed wavelengths of interest may in some embodiments include individual wavelengths, combinations of individual wavelengths, or wavelength bands from the visible, near-infrared and infrared ranges. Keller at [0013] Normalization may be achieved through a variety of means. In one such method, a uniform flat target is imaged by each imaging device 504 and filter 502 combination and under varying illumination intensities and exposures. From analysis of this set of flat-field calibration imagery, it is possible to calculate per pixel (or per group of pixels to average out noise) normalization coefficients for each imaging device 504. This method of intensity normalization includes a subroutine to remove areas of the monochrome images that are either above or below set boundary levels of intensity. This is done so that areas of the image which receive levels of light too high or too low for proper image processing are removed before the computation across the image is done. Such areas could be highlighted in a different way from the manner in which suspected abnormalities are highlighted (as described below), distinguishing them for the user. If the user so chose, he/she could position the tissue in such a way as to provide more or less light to the unprocessed areas. Keller at [0183] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	Keller discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. The invention also includes a system which includes the optical scope or apparatus of the invention. In such a system, the optical scope is electronically coupled (e.g., by wire, optical or wireless communications) to a computer system. The computer system may, for example, include typical components of a desktop or laptop computer, such as a computer processor; a means for transmitting image data from the one or more imaging devices to the computer processor; an input device electronically coupled to the computer processor; and/or an output device electronically coupled to the computer processor. Preferably the computer is programmed (e.g., includes code loaded in the computer processor and/or stored on a disk) to permit the user to control one or more system capabilities. The means for transmitting image data from the one or more imaging devices to the computer processor may be any means for electronically transmitting data, for example, a wireless communications device. Keller at [0010] Though monochrome area cameras are the preferred embodiment for the imaging devices 504 of this component 700 of the invention, any full-frame imaging device that outputs an electronic image may also suffice to capture image data from the filters and transmit the data to the computational system 700. (By “full-frame”, it is implied that the resolution of the imaging device must be, for example, over about 19,000 pixels, more particularly over about 60,000 pixels. In other embodiments of the invention, the minimum resolution for the imaging devices may be about 100,000 pixels, about 500,000 pixels, or about 1,000,000 pixels, or more.) Moreover, in some embodiments, a single imaging device 504 may be used to capture light from more than one filter/lens combination. In a preferred embodiment, the imaging devices 504 are capable of imaging light from all wavelengths of interest, including for example, the UV, visible, NIR and IR bands. Keller at [0149]

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	Figure 5. Multiple-Frequency Optical Imaging Subsystem Schematic Diagram  **Number** / **Description** 500 — Multiple-Wavelength Imaging Optical Subsystem 501 — Entry Lens Set (*from Conventional Optical Scope **300***) 502 — Filters 503 — Lens Sets 504 — Imaging Devices 505 — Flat-Black Absorbing Plate 700 — Computational System Keller at Fig. 5 The electronic imagery from the imaging devices 504 can be transmitted, for example, to the computational system 700 or other system components 100 b of the invention for processing. Keller at [0153] In particular, the imaging devices 504 should be digitally connected to and provide output to the computational system 700 of the invention.

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	Keller at [0154] The optical scope system 100 of the invention suitably includes a computational system 700, for accomplishing the image processing and analytical functions of the invention. The computational system 700 of the invention accepts input from the optical scope 100 a via the MWIOS 500. The computational system 700 of the invention may include one or more computer processors, memory devices, data storage devices, data transmission devices, and output devices, such as the display unit of the user console, as well as printers, and the like. In particular, the computational system will accept data from the imaging devices 504 of the MWIOS 500 (e.g., as described above in Section 6.1.5). Output will include, among other things, the diagnostic imagery as described below in Section 6.1.9. The computational system 700 is programmed to analyze and to compare images of specific light wavelengths. Keller at [0156] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is	Keller discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. The invention also includes a system which includes the optical scope or apparatus of the invention. In such a system, the optical scope is electronically coupled (e.g., by wire, optical or wireless communications) to a computer system. The computer system may, for example, include typical components of a desktop or laptop computer, such as a computer processor; a means for transmitting image data from the one or more imaging devices to the computer processor; an input device

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capable of storing a history of at least a portion of the received output status over a specified period of time.	electronically coupled to the computer processor; and/or an output device electronically coupled to the computer processor. Preferably the computer is programmed (e.g., includes code loaded in the computer processor and/or stored on a disk) to permit the user to control one or more system capabilities. The means for transmitting image data from the one or more imaging devices to the computer processor may be any means for electronically transmitting data, for example, a wireless communications device. Keller at [0010] Though monochrome area cameras are the preferred embodiment for the imaging devices 504 of this component 700 of the invention, any full-frame imaging device that outputs an electronic image may also suffice to capture image data from the filters and transmit the data to the computational system 700. (By “full-frame”, it is implied that the resolution of the imaging device must be, for example, over about 19,000 pixels, more particularly over about 60,000 pixels. In other embodiments of the invention, the minimum resolution for the imaging devices may be about 100,000 pixels, about 500,000 pixels, or about 1,000,000 pixels, or more.) Moreover, in some embodiments, a single imaging device 504 may be used to capture light from more than one filter/lens combination. In a preferred embodiment, the imaging devices 504 are capable of imaging light from all wavelengths of interest, including for example, the UV, visible, NIR and IR bands. Keller at [0149] The electronic imagery from the imaging devices 504 can be transmitted, for example, to the computational system 700 or other system components 100 b of the invention for processing. Keller at [0153] In particular, the imaging devices 504 should be digitally connected to and provide output to the computational system 700 of the invention. Keller at [0154] The optical scope system 100 of the invention suitably includes a computational system 700, for accomplishing the image processing and analytical functions of the invention. The computational system

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	700 of the invention accepts input from the optical scope 100 a via the MWIOS 500. The computational system 700 of the invention may include one or more computer processors, memory devices, data storage devices, data transmission devices, and output devices, such as the display unit of the user console, as well as printers, and the like. In particular, the computational system will accept data from the imaging devices 504 of the MWIOS 500 (e.g., as described above in Section 6.1.5). Output will include, among other things, the diagnostic imagery as described below in Section 6.1.9. The computational system 700 is programmed to analyze and to compare images of specific light wavelengths. Keller at [0156] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	Keller discloses or renders obvious wherein the measurement system is configured to use artificial intelligence in making decisions. In the system aspect of the invention, the computer system may be programmed or include a program or utility stored on a storage medium which instructs the processor to identify variations in spectral signatures across a series of images from the imaging devices. For example, the variations in spectral signatures are associated with tissue abnormalities, such as pre-cancerous and/or cancerous abnormalities, glucose abnormalities, and/or burns. Such abnormalities may, for example, be found in tissue in the gynecological tract, the gastrointestinal tract, the dermis and the epidermis. In a preferred embodiment, the analysis for abnormalities is an analysis of optical characteristics of the epithelial tissue of the cervix or colon. Keller at [0025]

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	Intensity normalization could be carried out automatically using the embedded software architecture of the invention. Alternatively, the invention could support a mechanism whereby the user selects an area of the image which he/she knows to be healthy, and the optical properties of this area would be used to normalize the remaining sectors of the image. Keller at [0184] Examination for Areas of Abnormal Spectral Behavior. The computational system 700 of the invention includes a method for recognizing spectral anomalies across the narrowband wavelength-images of the substrate 101, for instance tissue, under inspection. Keller at [0185] Lesions can be automatically detected by comparing the data obtained from target tissue areas to these standardized data patterns. Thus, in one aspect of the invention, a potential lesion is detected when a tissue region is identified which has a multi-wavelength response pattern that (a) significantly matches the standardized data pattern of a target lesion, and/or (b) differs significantly from the multi-wavelength response pattern of comparable normal tissue in the subject. Keller at [0220] Referring to FIG. 1 and FIG. 8, according to the method, the entry lens 103 of the optical scope 100 a is positioned at an appropriate distance from the target tissue substrate 101 on the subject (ST1, ST2). This positioning step may be preceded by appropriate patient positioning or surgical steps necessary to expose or otherwise provide access to the target tissue substrate 101. Exact positioning will vary depending on a variety of factors, such as the brightness of the light being used and the type of tissue substrate 101 being analyzed. The optical scope 100 a is appropriately positioned when the scope can collect sufficient light to perform its function, i.e., gather sufficient reflected light to identify a lesion, and preferably sufficient light information to permit the system 100 to identify the lesion and differentiate the lesion from other lesions. Keller at [0222]

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	The components of the phantoms can be chosen based on their own absorption and scattering coefficients; they can include one or more of: Intralipid™, a fat emulsion that mimics bulk tissue; polystyrene spheres, which serve to scatter light in a manner predicted by Mie theory; and hemoglobin, the component of blood that absorbs light in narrow bands; and India ink, which absorbs light over a broad spectral range. Keller at [0292] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Keller discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. In the system aspect of the invention, the computer system may be programmed or include a program or utility stored on a storage medium which instructs the processor to identify variations in spectral signatures across a series of images from the imaging devices. For example, the variations in spectral signatures are associated with tissue abnormalities, such as pre-cancerous and/or cancerous abnormalities, glucose abnormalities, and/or burns. Such abnormalities may, for example, be found in tissue in the gynecological tract, the gastrointestinal tract, the dermis and the epidermis. In a preferred embodiment, the analysis for abnormalities is an analysis of optical characteristics of the epithelial tissue of the cervix or colon. Keller at [0025] The computational system 700 can measure and compare various spectral parameters, such as scattering and absorption characteristics, across a spectral range. This range may, for example, include wavelengths

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	from the ultra-violet, visible, near-infrared and infrared bands. The MWIOS 500 suitably may include a filter in the filter set 502 for each wavelength being analyzed. Keller at [0158] Examination for Areas of Abnormal Spectral Behavior. The computational system 700 of the invention includes a method for recognizing spectral anomalies across the narrowband wavelength-images of the substrate 101, for instance tissue, under inspection. Keller at [0185] Lesions can be automatically detected by comparing the data obtained from target tissue areas to these standardized data patterns. Thus, in one aspect of the invention, a potential lesion is detected when a tissue region is identified which has a multi-wavelength response pattern that (a) significantly matches the standardized data pattern of a target lesion, and/or (b) differs significantly from the multi-wavelength response pattern of comparable normal tissue in the subject. Keller at [0220] Referring to FIG. 1 and FIG. 8, according to the method, the entry lens 103 of the optical scope 100 a is positioned at an appropriate distance from the target tissue substrate 101 on the subject (ST1, ST2). This positioning step may be preceded by appropriate patient positioning or surgical steps necessary to expose or otherwise provide access to the target tissue substrate 101. Exact positioning will vary depending on a variety of factors, such as the brightness of the light being used and the type of tissue substrate 101 being analyzed. The optical scope 100 a is appropriately positioned when the scope can collect sufficient light to perform its function, i.e., gather sufficient reflected light to identify a lesion, and preferably sufficient light information to permit the system 100 to identify the lesion and differentiate the lesion from other lesions. Keller at [0222] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Keller discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. As noted above, the apparatus of the invention includes a light source for illuminating a substrate. The light source may, for example, emit wavelengths comprising wideband white light, including all or portions of the visible, near-infrared and infrared ranges. The light source may, for example, include a physically continuous light source, a ring light, and/or one or more point light sources. The light source may be filtered to remove wavelengths not of interest. For example, wavelengths that can cause image corruption and/or undesirable thermal effects in the images and/or patient discomfort may be removed. Further, the light source may be supplemented with additional light in one or more wavelengths of interest. In certain embodiments, the light source does not include or consist of a xenon light source. Further, in some embodiments, the light source does not include or consist of a UV light source. In some embodiments, the light source includes neither a xenon light source nor a UV light source. The system analyzes wavelengths of interest, which are in some embodiments selected from wavelengths within the visible, near-infrared and infrared bands of light. In some embodiments, the light source emits light comprising one or more wavelengths selected from the group consisting of visible, near-infrared and infrared bands of light. The analyzed wavelengths of interest may in some embodiments include individual wavelengths, combinations of individual wavelengths, or wavelength bands from the visible, near-infrared and infrared ranges. Keller at [0013] Normalization may be achieved through a variety of means. In one such method, a uniform flat target is imaged by each imaging device 504 and filter 502 combination and under varying illumination intensities and exposures. From analysis of this set of flat-field calibration imagery, it is possible to calculate per

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	pixel (or per group of pixels to average out noise) normalization coefficients for each imaging device 504. This method of intensity normalization includes a subroutine to remove areas of the monochrome images that are either above or below set boundary levels of intensity. This is done so that areas of the image which receive levels of light too high or too low for proper image processing are removed before the computation across the image is done. Such areas could be highlighted in a different way from the manner in which suspected abnormalities are highlighted (as described below), distinguishing them for the user. If the user so chose, he/she could position the tissue in such a way as to provide more or less light to the unprocessed areas. Keller at [0183] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Keller discloses or renders obvious the measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above An apparatus for optically analyzing a substrate. The apparatus includes: (a) a light source for directing light onto the substrate; (b) optics for creating an optical path from light reflected from the substrate; and (c) a multiple wavelength imaging optical subsystem positioned in the optical path. The multiple wavelength imaging optical subsystem includes: (i) one or more filters which are capable of one or both of: (1) being alternatively or sequentially interposed in the optical path to extract one or more of wavelengths or wavelength bands of interest; or (2) having their wavelength selectivity adjusted to extract one or more wavelengths or wavelength bands of interest; and (ii) one or more imaging devices

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	positioned to image the extracted wavelengths or wavelength bands of interest from the one or more filters; (d) an imaging device positioned in the optical path. Also a method is included, making use of the apparatus for analysis of a substrate. Keller at [Abstract] As noted above, the apparatus of the invention includes a light source for illuminating a substrate. The light source may, for example, emit wavelengths comprising wideband white light, including all or portions of the visible, near-infrared and infrared ranges. The light source may, for example, include a physically continuous light source, a ring light, and/or one or more point light sources. The light source may be filtered to remove wavelengths not of interest. For example, wavelengths that can cause image corruption and/or undesirable thermal effects in the images and/or patient discomfort may be removed. Further, the light source may be supplemented with additional light in one or more wavelengths of interest. In certain embodiments, the light source does not include or consist of a xenon light source. Further, in some embodiments, the light source does not include or consist of a UV light source. In some embodiments, the light source includes neither a xenon light source nor a UV light source. The system analyzes wavelengths of interest, which are in some embodiments selected from wavelengths within the visible, near-infrared and infrared bands of light. In some embodiments, the light source emits light comprising one or more wavelengths selected from the group consisting of visible, near-infrared and infrared bands of light. The analyzed wavelengths of interest may in some embodiments include individual wavelengths, combinations of individual wavelengths, or wavelength bands from the visible, near-infrared and infrared ranges. Keller at [0013] In a preferred embodiment, the system includes multiple imaging devices and one or more utilities programmed to geometrically register the geometry of the substrate to the pixels of the multiple imaging devices and/or normalize intensity values across multiple images of the substrate from the multiple imaging devices. In certain embodiments, the normalization is accomplished automatically. The normalization may be based on an area of said imagery selected by input from a user. The system may include a utility programmed to extract subsections of said substrate wherein one or both of excessive light intensity or insufficient light intensity prevents imaging of said substrate with sufficient quality to permit the desired analysis. For example, the utility may be programmed to omit such subsections from

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	diagnostic processing and/or to inform the user that said subsections will require re-imaging during one or more of adjusted lighting, filtering, or positioning circumstances. The system may include a utility programmed to identify spectral attributes in image sub-areas characteristic to a tissue abnormality or not characteristic of normal tissue and provide output to a user indicating the location of such image sub-areas. The analysis and output may include classification of the tissue abnormality. Keller at [0028] Normalization may be achieved through a variety of means. In one such method, a uniform flat target is imaged by each imaging device 504 and filter 502 combination and under varying illumination intensities and exposures. From analysis of this set of flat-field calibration imagery, it is possible to calculate per pixel (or per group of pixels to average out noise) normalization coefficients for each imaging device 504. This method of intensity normalization includes a subroutine to remove areas of the monochrome images that are either above or below set boundary levels of intensity. This is done so that areas of the image which receive levels of light too high or too low for proper image processing are removed before the computation across the image is done. Such areas could be highlighted in a different way from the manner in which suspected abnormalities are highlighted (as described below), distinguishing them for the user. If the user so chose, he/she could position the tissue in such a way as to provide more or less light to the unprocessed areas. Keller at [0183] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	
14. The measurement system of claim 11, wherein	Keller discloses or renders obvious the measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's),

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the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above The invention provides an apparatus, system and method for optically analyzing a substrate. The apparatus, system and method of the invention are useful for recording and analyzing the optical characteristics of the substrate. The substrate is suitably a tissue substrate, for instance, human tissue and/or animal tissue, and the analysis may relate to optical characteristics useful for identifying tissue abnormalities, such as pre-cancerous and cancerous lesions, glucose abnormalities and burn injuries. However, it will be appreciated that the optical scope will be useful in the analysis of other substrates as well, including for example, in vitro tissue samples, manufactured materials, plastics, metals, soils, and other materials. Keller at [0060] Examples of light sources suitable for use with the diagnostic endoscope of the invention include xenon arc lamps, quartz halogen lamps, incandescent sources, LEDs, and many others. One preferred embodiment employs a quartz halogen lamp, which tends to be stable, and yields a high output without an excessive amount of heat. Keller at [0090] Operation in Principle. The embodiment of the invention that detects tissue lesions operates in principle in the following way: certain wavelengths of light are selected for their known, distinct behaviors when interacting with healthy tissue and with tissue lesions; these wavelengths are extracted from light reflected off of the tissue and imaged; the wavelength-specific images are studied for the pre-determined characteristics associated with tissue lesions. Keller at [0214]

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Keller discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. Light Source. The optical scope 100 a of the invention typically includes one or more components of a conventional optical scope 300, such as a light source 301. Conventional optical scopes 300 use light sources 301 that emit visible wavelengths. Many such light sources 301 are currently available on the market. In some embodiments, the native source on a conventional scope 300 will be insufficient for the analytical and diagnostic applications of the present invention, since the necessary range of wavelengths of the invention will in some embodiments lie outside the visible band. Thus, the conventional visible light source 301 will typically be replaced with a light source that includes wavelengths sufficient to enable the analytical or diagnostic application(s) for which the inventive optical scope 100 a is intended. Keller at [0102] Imaging Device (with Lens). A conventional optical scope 300 will also typically include an imaging device 305 and an accompanying lens. In other embodiments, the imaging device 305 may be absent. The imaging device 305 may function to record high-resolution, full-color (i.e., wide-band visible-light) images or may record other suitable bands of light. The imaging device 305 serves to record imagery collected during the examination. It may also provide a means to enable a digital console display of the examination imagery. In one embodiment of the invention, the imaging device 305 can provide a color video image that can be optically combined with the wavelength-specific images from the imaging devices 504 of the MWIOS 500, for display purposes.

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	Keller at [0108] The imaging device 305 may comprise a color video camera, such as an area camera, a line-scan camera, a focal plane array, or the like. For example, its technology may be based on charged-couple device (CCD), complimentary metal-oxide semiconductor (CMOS) or Indium-Gallium-Arsenide (InG aAs) detectors. In the optical path, the imaging device 305 may, for example, follow the beam-splitter 304 and output its imagery to a user interface (e.g., the eyepiece 306 or user console). The resolution of the imaging device 305 may be, for example, greater than 300,000 pixels. Keller at [0109] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Keller discloses or renders obvious the measurement system of claim 15, wherein the first arc and the second arc are concentric. *See* claim 15 above One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Keller discloses or renders obvious a wearable device for use with a smart phone or tablet. *See* claim 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters,	Keller discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* claim 11[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources	Keller discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelength.

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having an initial light intensity, an input optical beam having one or more optical wavelengths, and	The invention includes an apparatus for optically analyzing a substrate. The apparatus generally includes a light source for directing light onto the substrate; optics for creating an optical path from light reflected from the substrate; a multiple wavelength imaging optical subsystem (MWIOS) positioned in the optical path; and an imaging device positioned in the optical path. The MWIOS generally includes one or more filters, which can be alternatively or sequentially interposed in the optical path to extract wavelengths or wavelength bands of interest and/or which may have their wavelength selectivity adjusted to extract one or more wavelengths or wavelength bands of interest; and one or more imaging devices positioned to image the extracted wavelengths or wavelength bands of interest from the one or more filters. The apparatus of the invention may also include a means for transmitting image data from the one or more imaging devices, which means can be electronically coupled to a system to permit transmission of data from the imaging device to the system. Keller at [0007] The optical scope 10 a of the invention may include a light source 102. The light source 102 may be integral with or separate from the optical scope 100 a. The light source 102 functions to emit light, e.g., wideband white light, encompassing all wavelengths of interest. Wavelengths of interest may, for example, include wavelengths within any of the ultra-violet, visible, near-infrared or infrared ranges. The light source 102 emits light onto the surface of the substrate 101 to be examined. This substrate 101, e.g., a tissue substrate, may be illuminated by one or more continuous and/or point light sources. The continuous or point light source(s) may be oriented in any of a variety of patterns, e.g., circular, semicircular or other semi-parallel pattern. These sources can, for example, be centered around the scope's optical path; they can be oriented off-axis; or they may share the optical path of the scope itself. Keller at [0087] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Keller discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* claim 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue.	Keller discloses or renders obvious the measurement device further comprising a receiver configured to:capture light while the semiconductor sources are off and convert the captured light into a first signal and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue. *See* claim 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Keller discloses or renders obvious the receiver configured to synchronize to the modulation of the at least one of the semiconductor sources. *See* claim 11[a], 11[b], 11[g], 19[a], 19[b], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Keller discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* claim 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Keller discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* claim 11[a] , 11[b], 19[a].

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Keller discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* claim 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Keller discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* claim 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link	Keller discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link. *See* claim 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Keller discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 13, 19 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Keller discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claim 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Keller discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claim 16, 21 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' In validity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Keller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Keller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT D19

U.S. Pat. No. 10,874,304 in view of U.S. Patent No. 7,139,076 to Ralf Marbach ("Marbach")

As described in detail below, Marbach (individually or collectively) anticipates and/or renders obvious claims 11-16, 19-22 ("Asserted Claims") of U.S. Patent No. 10,874,304 (the "'304 Patent") under 35 U.S.C. §102 and/or §103, either and/or in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits D1-D18, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '304 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. . This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

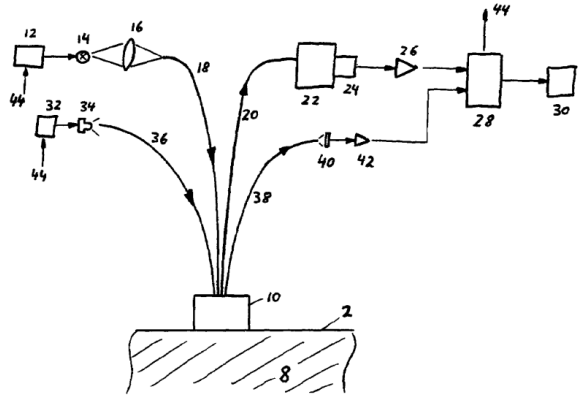
The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Marbach. The cited portions of Marbach are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Marbach. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Marbach "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Marbach does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Marbach (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Marbach anticipates and/or renders obvious the Asserted Claims of the '304 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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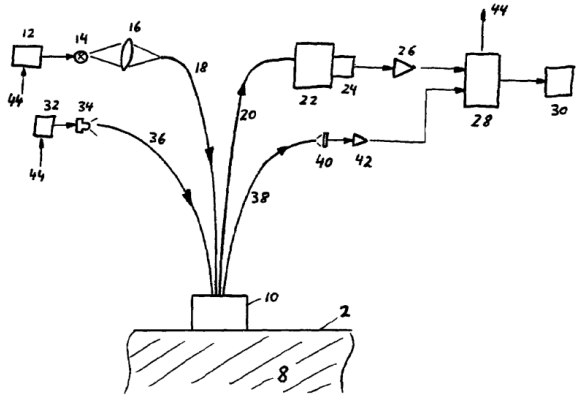
’304 Patent	Marbach
Claim 11	
11[pre]. A measurement system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Marbach discloses or renders obvious a measurement system. Apparatus and methods for stable and reproducible optical diffuse reflection measurement are described. Light sources and photodetectors are used such that at least two points of light entry and at least two points of light exit are established on the surface of the sample. The light sources are modulated and the detector outputs are demodulated such that the signals associated with the at least four optical measurement beams are individually detected. The signals are processed such that all instabilities generated at the surface of the sample are canceled out. In effect, the accuracy of the measurement is increased by having only the deeper layers of the sample contribute to the result. The geometry of the probe can be optimized for specific sampling depths and for specific measurement applications. Spectroscopic referencing can be eliminated since instabilities of light emission and detection are also canceled out. Marbach at [Abstract] From a hardware point-of-view, stability is often significantly easier to achieve than r-accuracy. Consider FIG. 2, showing a preferred embodiment of an optical diffuse reflection measurement system utilizing the basic 2×2 probe geometry of, e.g., FIG. 1B. An electrical driver 12 powers a light source 14 emitting broad-band radiation covering the whole wavelength range of interest, which is collected by a lens 16 and guided through a fiber 18 to sample 8. The distal end of fiber 18 touches surface 2 of sample 8 and is therefore identical to entrance point A (not shown). Exit point ii (not shown) is formed in a similar way by the distal end of a pickup fiber 20. Fiber 20 guides the collected light to a spectrograph 22, where the light is spectrally dispersed and detected by a photodetector array 24. Marbach at 14:28-41.

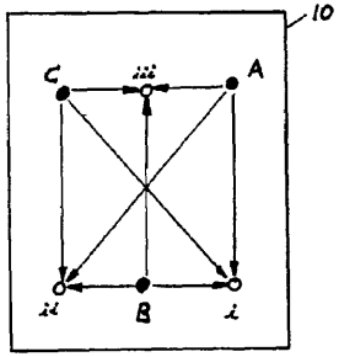
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	 Fig.2 Marbach at Fig. 2. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[a]. a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths;	Marbach discloses or renders obvious a wearable measurement device for measuring one or more physiological parameters, including a light source comprising a plurality of semiconductor sources that are configured to generate an output optical beam with one or more optical wavelengths. As a first and somewhat surprising example, assume that beams Bii and Bi are signal-redundant and that beams Aii and Ai are also made signal-redundant, e.g., by moving entry point A in FIG. 1B further to the left until the connection line A-B is orthogonal to connection line ii-i. The result of Eq.(3) is then, R≅1, which does not seem to be very interesting at first glance. However, the small deviation from the ideal R=1 is now a very reliable indicator of the spatial non-uniformities of bulk layer 6, and of bulk layer 6 only, i.e., unaffected by any non-uniformities of surface layer 4 or any surface noise for that matter. A practical application of this type of probe is a simple and rugged device for the detection of spatial non-uniformities in the human dermis, e.g., for skin cancer detection. A miniaturized, battery-

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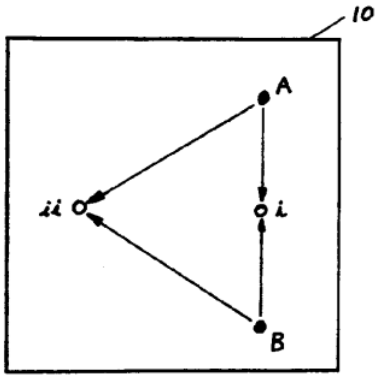
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	powered probe of this kind can be built from, e.g., LEDs and Silicon photodiodes, and could be manually scanned across suspected skin areas. Marbach at 9:15-28. The disclosed matter can thus be applied with significant benefit to a wide range of optical measurement applications. The most significant benefit is expected in two areas: (a) ill-posed measurements of small signals close to the hardware noise-floor, e.g., measurement of urea concentration in the interstitial fluid of human skin, and (b) well-posed measurements of large but spectrally-broad signals with SNRX-values that can not be sufficiently improved between wavelengths alone, e.g., measurements of changes in scatter coefficient or measurements that are affected by extraordinarily large amounts of surface noise, e.g., heart rate monitoring on exercising athletes. Marbach at 13:1-12. From a hardware point-of-view, stability is often significantly easier to achieve than r-accuracy. Consider FIG. 2, showing a preferred embodiment of an optical diffuse reflection measurement system utilizing the basic 2×2 probe geometry of, e.g., FIG. 1B. An electrical driver 12 powers a light source 14 emitting broad-band radiation covering the whole wavelength range of interest, which is collected by a lens 16 and guided through a fiber 18 to sample 8. The distal end of fiber 18 touches surface 2 of sample 8 and is therefore identical to entrance point A (not shown). Exit point ii (not shown) is formed in a similar way by the distal end of a pickup fiber 20. Fiber 20 guides the collected light to a spectrograph 22, where the light is spectrally dispersed and detected by a photodetector array 24. Marbach at 14:28-41.

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	 Fig.2 Marbach at Fig. 2. The confocality effect also applies to beam Bii, however, there will be no interference effects when detecting SBii because the interferometer is (with virtual certainty) far from zero-path difference with regard to this beam. Thus, detection of optical power SBii is not as concentrated around point 74 as is detection of SAii, and in general, SBii will be detected from shallower depth. By choosing wavelengths λSLED and λLED to be close to each other, surface instabilities are effectively canceled out. Marbach at 18:10-19. For example, in many industrial process-control applications the ability to measure the depth profile of moisture is important to fine-tune yield and quality of production processes, e.g., when making wooden boards or foodstuff. Another, particularly important biomedical application example is the measurement of the scattering coefficient, μS, of human skin as an indicator of the blood glucose concentration. It is known that the time profile of the glucose concentration in the skin is not perfectly correlated with the one in blood. One method that has been proposed to decrease the resulting so-called tracking error, is to make several consecutive skin measurements, say, at 10 minute intervals, then from these compute the rate of change in skin glucose concentration [(mg/dL)/minute], and then from the rate of change compute a correction factor to improve the accuracy of the current blood concentration measurement result. The point is, a depth-profile measurement at a single moment in time can be used to decrease tracking error in a similar way. Best tracking is achieved when probing the skin at a depth of about 150 microns,

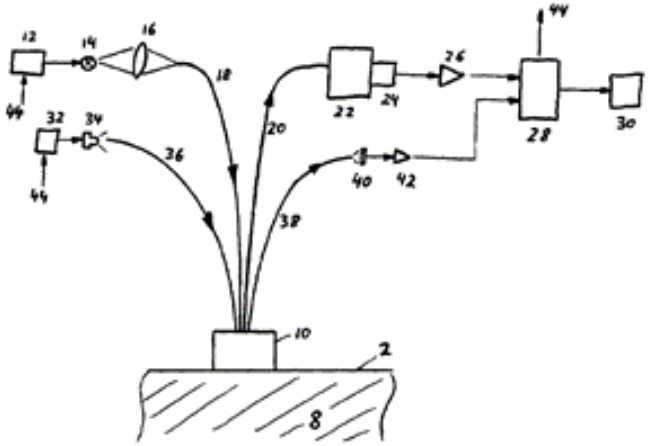
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	because a dense network of capillaries is located at this depth (so-called venous plexus). Probing at other depths will yield concentration values that are relatively less well tracking with the concentration in the blood, i.e., information about the overall skin tracking error is embedded in the differences between the concentrations at different depths. Higher-order probes can use this information to improve the accuracy a.k.a. SNRX of the measurement, by subtracting out tracking-noise in the same way that the differences between mutually-referencing beams are used to cancel out surface noise, viz., by applying the Wiener-filter method of signal-processing (see below) to the output data of the higher-order probe. Marbach at 18:58-19:22. An advantage of the Wiener filter method is that it seamlessly integrates multivariate data of different kinds into a single, optimal solution in a relatively straightforward way. Continuing the previous example, if the 3×3 probe of FIG. 5A is used for a spectroscopically resolved measurement of the scatter coefficient of human dermis, which then is used to predict the glucose concentration in blood, then the Wiener filter will automatically: cancel surface noise between beams, cancel spectrally interfering noise between wavelengths, and cancel tracking noise by locking in on differences in the skin glucose at different depths. Marbach at 21:18-28. Fig.5A  Marbach at Fig. 5.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[b]. the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources;	Marbach discloses or renders obvious the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources. Thus, all surface instabilities and all instabilities of light emission and detection are ratioed out, and the result R is dependent only on the optical properties of the deeper layers of the sample. Since the properties of the deeper layers are usually more stable than those at the surface, the accuracy a.k.a. SNRX of the measurement is usually improved. Marbach at 8:27-32. In summary, the probe schematically shown in FIG. 1E can accurately measure spectral differences in absorbance coefficient. It is also a first example showing how spectrally-multivariate data (two different wavelengths) can be combined with geometrically-multivariate data (four different measurement beams) to increase the overall accuracy a.k.a. SNRX of the measurement. This last statement prepares the ground for explaining the fundamental, and so far unrecognized, SNRX-advantage of multi-beam probes. All advantages mentioned so far stem from this one, fundamental advantage. Marbach at 11:57-67.

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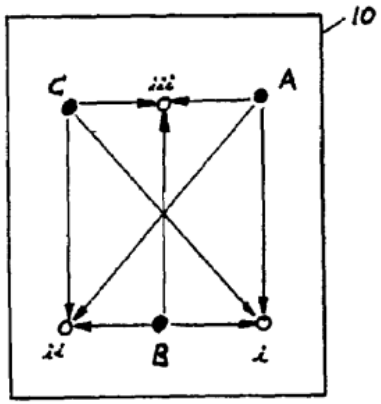
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	 Fig.1E Marbach at Fig. 1E. Synchronous detection, e.g., using alternating pulses from light source 14 and LED 34 and gated amplifiers, or frequency modulation and lock-in amplifiers, is preferred and can be achieved by having electronics 28 provide timing signals 44 to drivers 12 and 32. LED 34 is preferably selected to emit light at a wavelength λLED that is close to, or within, the wavelength range of interest in order to maximize the correlation between the instabilities experienced by the different optical beams. Electronics 28 computes the explicit-ratio diffuse reflection spectrum at each wavelength, λi, resolved by spectrograph 22 as follows: Marbach at 14:62-15:6. If r-accuracy is required, then fibers 18 and 36 have to be illuminated in identical ways, and light collected by fibers 20 and 38 has to be spectrally resolved, detected, and processed in identical ways. This can be achieved (not shown) by doubling elements 12, 14, 16 and 22, 24, 26 with elements 12′, 14′, 16′ and 22′, 24′, 26′; and by replacing elements 32, 34 with 12′, 14′, 16′ and elements 40, 42 with 22′, 24′, 26′ so that both illumination fibers 18 and 36 and both detection fibers 20 and 38 are equipped with identical sets of hardware. Electronics 28 contains control circuitry to modulate light sources 14 and 14′, e.g., by turning them on and off in alternating sequence.

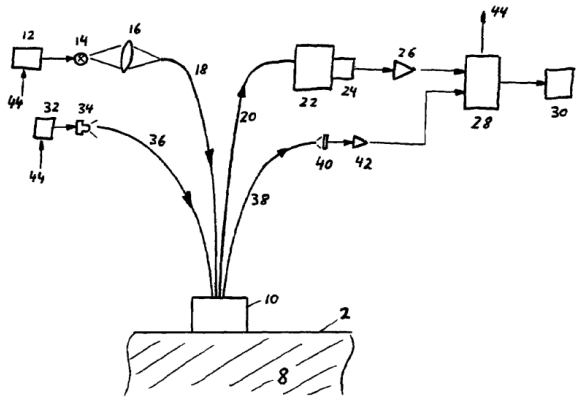
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	Marbach at 15:38-49.  Fig.2 Marbach at Fig. 2. The LEDs are preferably pulse-modulated with a pulse frequency on the order of several kHz. Low power, quasi-continuous operation is possible by measuring intermittently, e.g., one measurement lasting 10 seconds every 5 minutes. Battery operation is possible in many applications and solar cell powering is possible in some, depending on the sampling rate and SNRX requirements of the particular application. Marbach at 17:1-8. Best tracking is achieved when probing the skin at a depth of about 150 microns, because a dense network of capillaries is located at this depth (so-called venous plexus). Probing at other depths will yield concentration values that are relatively less well tracking with the concentration in the blood, i.e., information about the overall skin tracking error is embedded in the differences between the concentrations at different depths. Higher-order probes can use this information to improve the accuracy a.k.a. SNRX of the measurement, by subtracting out tracking-noise in the same way that the differences between mutually-referencing beams are used to cancel out surface noise, viz., by applying the Wiener-filter method of signal-processing (see below) to the output data of the higher-order probe.

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	Marbach at 19:9-22. The advantage of the Wiener filter method is that the overall measurement accuracy a.k.a. SNRX is optimized considering all types of measurement noises, including surface noise. Even though the Wiener filter may not get rid of 100% of the surface noise, it effectively cancels out all that surface noise that is in the way of measurement accuracy, keeping only that (small) part of the surface noise that happens to be in a data subspace with significant useful signal. For example, in the case of a 2×2 probe used in an application with dominant surface noise, the Wiener filter will be practically identical to the explicit-ratio result, Eq.(3). Depending on the details of the other noises affecting the measurement and their relative strength compared to the surface noise, there will be slight deviations, e.g., instead of the exact explicit-ratio filter, k·[+1−1−1+1]T (using vector notation), the Wiener filter may be, b=k·[+1.01−0.96−1.03+0.99]T, giving an output, Marbach at 20:43-59. An advantage of the Wiener filter method is that it seamlessly integrates multivariate data of different kinds into a single, optimal solution in a relatively straightforward way. Continuing the previous example, if the 3×3 probe of FIG. 5A is used for a spectroscopically resolved measurement of the scatter coefficient of human dermis, which then is used to predict the glucose concentration in blood, then the Wiener filter will automatically: cancel surface noise between beams, cancel spectrally interfering noise between wavelengths, and cancel tracking noise by locking in on differences in the skin glucose at different depths. Marbach at 21:18-28.

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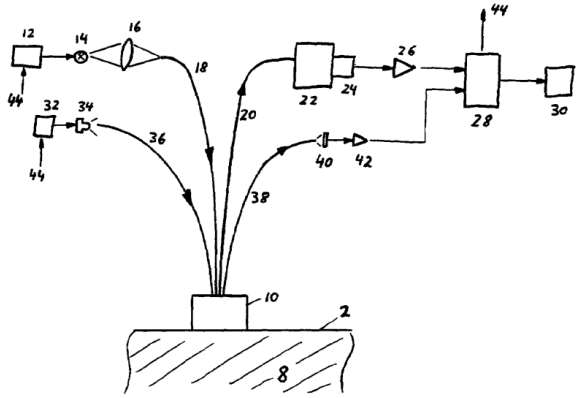
’304 Patent	Marbach
	Fig.5A  Marbach at Fig. 5. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[c]. the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample;	Marbach discloses or renders obvious a the wearable measurement device configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. From a hardware point-of-view, stability is often significantly easier to achieve than r-accuracy. Consider FIG. 2, showing a preferred embodiment of an optical diffuse reflection measurement system utilizing the basic 2×2 probe geometry of, e.g., FIG. 1B. An electrical driver 12 powers a light source 14 emitting broad-band radiation covering the whole wavelength range of interest, which is collected by a lens 16 and guided through a fiber 18 to sample 8. The distal end of fiber 18 touches surface 2 of sample 8 and is therefore identical to entrance point A (not shown). Exit point ii (not shown) is formed in a similar

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	way by the distal end of a pickup fiber 20. Fiber 20 guides the collected light to a spectrograph 22, where the light is spectrally dispersed and detected by a photodetector array 24. Marbach at 14:28-41.  Fig.2 Marbach at Fig. 2. Housing 10, which can be substantially circular in shape with a diameter preferably smaller than about 4 cm, is fixed with a bracelet 66 to sample 8, e.g., the wrist of the human arm, much like a watch. Marbach at 16:39-43. For example, in many industrial process-control applications the ability to measure the depth profile of moisture is important to fine-tune yield and quality of production processes, e.g., when making wooden boards or foodstuff. Another, particularly important biomedical application example is the measurement of the scattering coefficient, μS, of human skin as an indicator of the blood glucose concentration. It is known that the time profile of the glucose concentration in the skin is not perfectly correlated with the one in blood. One method that has been proposed to decrease the resulting so-called tracking error, is to make several consecutive skin measurements, say, at 10 minute intervals, then from these compute the rate of change in skin glucose concentration [(mg/dL)/minute], and then from the rate of change compute a correction factor to improve the accuracy of the current blood concentration measurement result. The

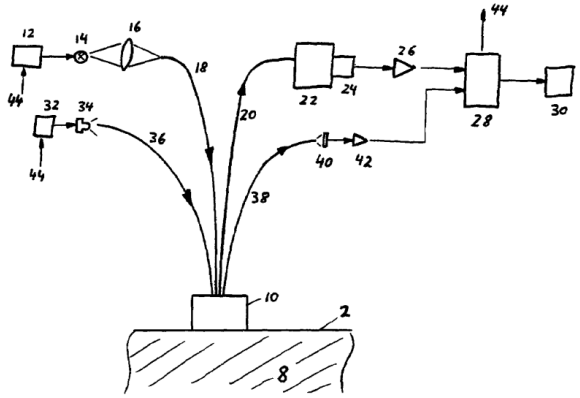
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	point is, a depth-profile measurement at a single moment in time can be used to decrease tracking error in a similar way. Best tracking is achieved when probing the skin at a depth of about 150 microns, because a dense network of capillaries is located at this depth (so-called venous plexus). Probing at other depths will yield concentration values that are relatively less well tracking with the concentration in the blood, i.e., information about the overall skin tracking error is embedded in the differences between the concentrations at different depths. Higher-order probes can use this information to improve the accuracy a.k.a. SNRX of the measurement, by subtracting out tracking-noise in the same way that the differences between mutually-referencing beams are used to cancel out surface noise, viz., by applying the Wiener-filter method of signal-processing (see below) to the output data of the higher-order probe. Marbach at 18:58-19:22. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[d]. the wearable measurement device further comprising a receiver configured to:	Marbach discloses or renders obvious the wearable measurement device further comprising a receiver. Apparatus and methods for stable and reproducible optical diffuse reflection measurement are described. Light sources and photodetectors are used such that at least two points of light entry and at least two points of light exit are established on the surface of the sample. The light sources are modulated and the detector outputs are demodulated such that the signals associated with the at least four optical measurement beams are individually detected. The signals are processed such that all instabilities generated at the surface of the sample are canceled out. In effect, the accuracy of the measurement is increased by having only the deeper layers of the sample contribute to the result. The geometry of the probe can be optimized for specific sampling depths and for specific measurement applications. Spectroscopic referencing can be eliminated since instabilities of light emission and detection are also canceled out. Marbach at [Abstract]

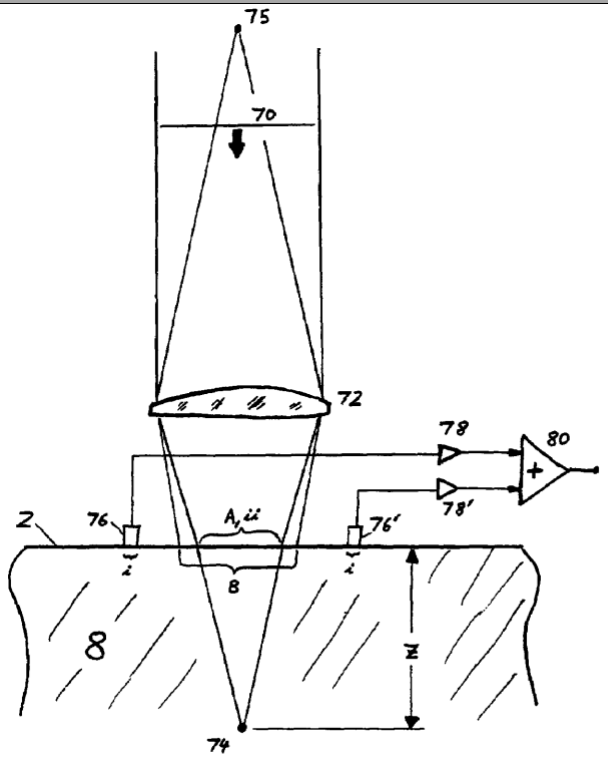
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	The entry and exit points schematically shown in FIGS. 1A–E can be realized in different ways using, e.g., LEDs and photodetectors located in close proximity to surface 2, or optical fibers contacting surface 2, or lenses or mirrors focussed at surface 2. Several preferred embodiments will be described in detail below. For now, we focus on the basic 2×2 geometry of the disclosed matter in order to explain the principal advantages of the invention first. We start with the assumption that only a single optical measurement wavelength (λ) is used, e.g., that only a single type of LED and single type of photodetector are used. ‘Single wavelength’ here does not necessarily mean that light sources emit a spectrally pure, narrow emission line, but rather, that the measurement is spectrally univariate, i.e., is not spectroscopically resolved into several signals from different λ-bands. Marbach at 7:17-32. From a hardware point-of-view, stability is often significantly easier to achieve than r-accuracy. Consider FIG. 2, showing a preferred embodiment of an optical diffuse reflection measurement system utilizing the basic 2×2 probe geometry of, e.g., FIG. 1B. An electrical driver 12 powers a light source 14 emitting broad-band radiation covering the whole wavelength range of interest, which is collected by a lens 16 and guided through a fiber 18 to sample 8. The distal end of fiber 18 touches surface 2 of sample 8 and is therefore identical to entrance point A (not shown). Exit point ii (not shown) is formed in a similar way by the distal end of a pickup fiber 20. Fiber 20 guides the collected light to a spectrograph 22, where the light is spectrally dispersed and detected by a photodetector array 24. Marbach at 14:28-41.

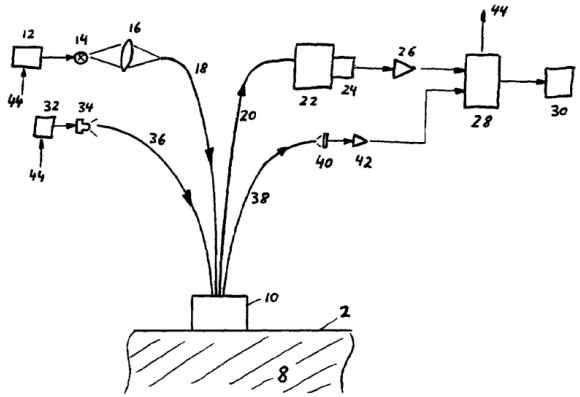
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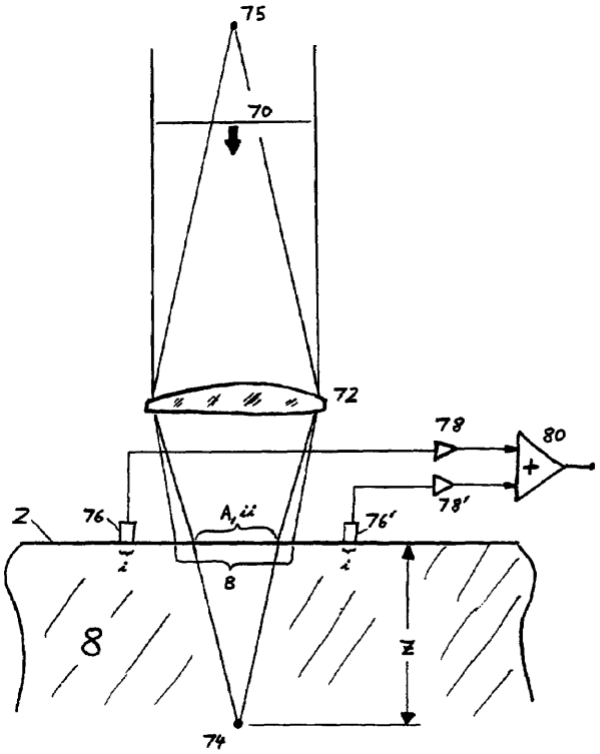
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	 Fig.2 Marbach at Fig. 2. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[e]. receive and process at least a portion of the analysis output beam reflected or transmitted from the sample,	Marbach discloses or renders obvious the receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample. Apparatus and methods for stable and reproducible optical diffuse reflection measurement are described. Light sources and photodetectors are used such that at least two points of light entry and at least two points of light exit are established on the surface of the sample. The light sources are modulated and the detector outputs are demodulated such that the signals associated with the at least four optical measurement beams are individually detected. The signals are processed such that all instabilities generated at the surface of the sample are canceled out. In effect, the accuracy of the measurement is increased by having only the deeper layers of the sample contribute to the result. The geometry of the probe can be optimized for specific sampling depths and for specific measurement applications.

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	Spectroscopic referencing can be eliminated since instabilities of light emission and detection are also canceled out. Marbach at [Abstract] The entry and exit points schematically shown in FIGS. 1A–E can be realized in different ways using, e.g., LEDs and photodetectors located in close proximity to surface 2, or optical fibers contacting surface 2, or lenses or mirrors focussed at surface 2. Several preferred embodiments will be described in detail below. For now, we focus on the basic 2×2 geometry of the disclosed matter in order to explain the principal advantages of the invention first. We start with the assumption that only a single optical measurement wavelength (λ) is used, e.g., that only a single type of LED and single type of photodetector are used. ‘Single wavelength’ here does not necessarily mean that light sources emit a spectrally pure, narrow emission line, but rather, that the measurement is spectrally univariate, i.e., is not spectroscopically resolved into several signals from different λ-bands. Marbach at 7:17-32. From a hardware point-of-view, stability is often significantly easier to achieve than r-accuracy. Consider FIG. 2, showing a preferred embodiment of an optical diffuse reflection measurement system utilizing the basic 2×2 probe geometry of, e.g., FIG. 1B. An electrical driver 12 powers a light source 14 emitting broad-band radiation covering the whole wavelength range of interest, which is collected by a lens 16 and guided through a fiber 18 to sample 8. The distal end of fiber 18 touches surface 2 of sample 8 and is therefore identical to entrance point A (not shown). Exit point ii (not shown) is formed in a similar way by the distal end of a pickup fiber 20. Fiber 20 guides the collected light to a spectrograph 22, where the light is spectrally dispersed and detected by a photodetector array 24. The electrical output signal of array 24 is amplified by a pre-amplifier 26 and fed into an electronic circuit 28 typically comprised of additional amplifiers, multiplexer, sample & hold, A/D converter, microprocessor or other digital signal processing hardware and software, and an optional user interface. Marbach at 14:28-46.

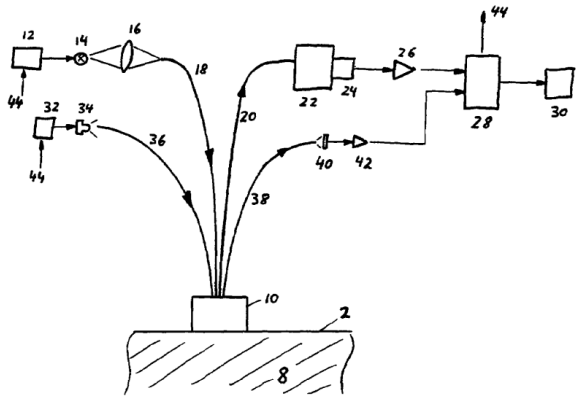
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	 Fig.2 Marbach at Fig. 2. The fact that illumination and pickup optics are confocal, and the coherent detection afforded by the interferometer, cause the reflected light to be preferably detected from point 74, i.e., the effective measurement cuvette through sample 8 is more or less given by a single scatter-event path: straight in, backscattered at point 74, and straight back out. Marbach at 17:46-55.

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	 Fig.4 Marbach at Fig. 4. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[f]. generate an output signal representing at least in part a non-invasive	Marbach discloses or renders obvious the receiver configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the sample.

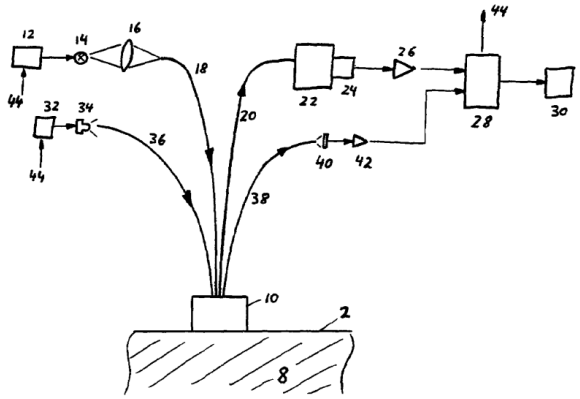
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	Marbach at 17:46-55.  Fig.4 Marbach at Fig. 4. For example, in many industrial process-control applications the ability to measure the depth profile of moisture is important to fine-tune yield and quality of production processes, e.g., when making wooden boards or foodstuff. Another, particularly important biomedical application example is the measurement of the scattering coefficient, μS, of human skin as an indicator of the blood glucose concentration. It is known that the time profile of the glucose concentration in the skin is not perfectly correlated with the one in blood. One method that has been proposed to decrease the resulting so-called tracking error, is to make several consecutive skin measurements, say, at 10 minute intervals, then from these compute the rate of change in skin glucose concentration [(mg/dL)/minute], and then from the rate of change compute a correction factor to improve the accuracy of the current blood concentration measurement result. The

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	point is, a depth-profile measurement at a single moment in time can be used to decrease tracking error in a similar way. Best tracking is achieved when probing the skin at a depth of about 150 microns, because a dense network of capillaries is located at this depth (so-called venous plexus). Probing at other depths will yield concentration values that are relatively less well tracking with the concentration in the blood, i.e., information about the overall skin tracking error is embedded in the differences between the concentrations at different depths. Higher-order probes can use this information to improve the accuracy a.k.a. SNRX of the measurement, by subtracting out tracking-noise in the same way that the differences between mutually-referencing beams are used to cancel out surface noise, viz., by applying the Wiener-filter method of signal-processing (see below) to the output data of the higher-order probe. Marbach at 18:58-19:22. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[g]. synchronize to the light source,	Marbach discloses or renders obvious the receiver configured to synchronize to the light source. Synchronous detection, e.g., using alternating pulses from light source 14 and LED 34 and gated amplifiers, or frequency modulation and lock-in amplifiers, is preferred and can be achieved by having electronics 28 provide timing signals 44 to drivers 12 and 32. LED 34 is preferably selected to emit light at a wavelength λLED that is close to, or within, the wavelength range of interest in order to maximize the correlation between the instabilities experienced by the different optical beams. Electronics 28 computes the explicit-ratio diffuse reflection spectrum at each wavelength, λi, resolved by spectrograph 22 as follows: Marbach at 14:62-15:6. If r-accuracy is required, then fibers 18 and 36 have to be illuminated in identical ways, and light collected by fibers 20 and 38 has to be spectrally resolved, detected, and processed in identical ways.

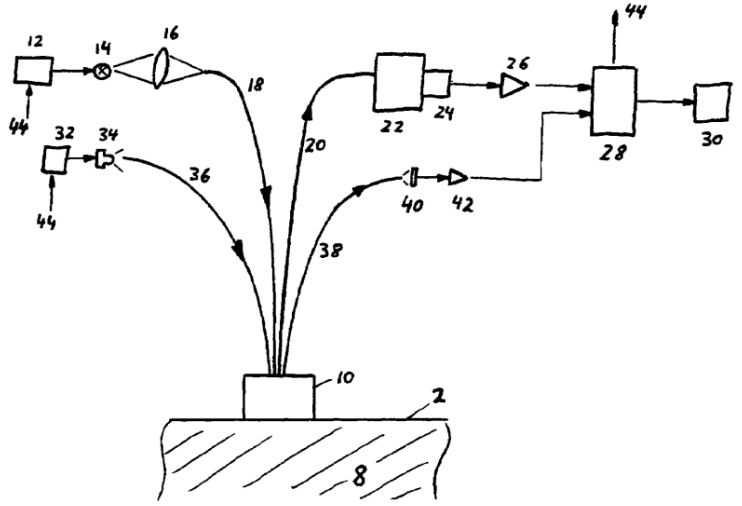
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	This can be achieved (not shown) by doubling elements 12, 14, 16 and 22, 24, 26 with elements 12′, 14′, 16′ and 22′, 24′, 26′; and by replacing elements 32, 34 with 12′, 14′, 16′ and elements 40, 42 with 22′, 24′, 26′ so that both illumination fibers 18 and 36 and both detection fibers 20 and 38 are equipped with identical sets of hardware. Electronics 28 contains control circuitry to modulate light sources 14 and 14′, e.g., by turning them on and off in alternating sequence. Marbach at 15:38-49.  Fig.2 Marbach at Fig. 2. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[h]. capture light while the semiconductor sources are off and convert the captured light into a first signal,	Marbach discloses or renders obvious the receiver configured to capture light while the semiconductor sources are off and convert the captured light into a first signal.

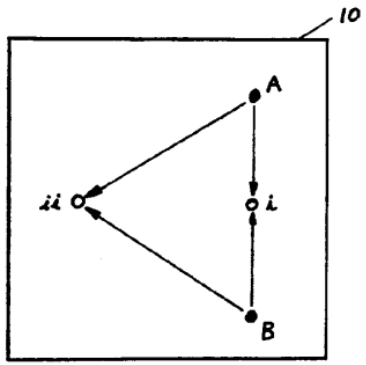
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	Synchronous detection, e.g., using alternating pulses from light source 14 and LED 34 and gated amplifiers, or frequency modulation and lock-in amplifiers, is preferred and can be achieved by having electronics 28 provide timing signals 44 to drivers 12 and 32. LED 34 is preferably selected to emit light at a wavelength λLED that is close to, or within, the wavelength range of interest in order to maximize the correlation between the instabilities experienced by the different optical beams. Electronics 28 computes the explicit-ratio diffuse reflection spectrum at each wavelength, λi, resolved by spectrograph 22 as follows: Marbach at 14:62-15:6. If r-accuracy is required, then fibers 18 and 36 have to be illuminated in identical ways, and light collected by fibers 20 and 38 has to be spectrally resolved, detected, and processed in identical ways. This can be achieved (not shown) by doubling elements 12, 14, 16 and 22, 24, 26 with elements 12′, 14′, 16′ and 22′, 24′, 26′; and by replacing elements 32, 34 with 12′, 14′, 16′ and elements 40, 42 with 22′, 24′, 26′ so that both illumination fibers 18 and 36 and both detection fibers 20 and 38 are equipped with identical sets of hardware. Electronics 28 contains control circuitry to modulate light sources 14 and 14′, e.g., by turning them on and off in alternating sequence. Marbach at 15:38-49.  Fig.2 Marbach at Fig. 2.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[i]. capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample,	Marbach discloses or renders obvious the receiver configured to capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a part of the at least a portion of the analysis output beam reflected or transmitted from the sample. If r-accuracy is required, then fibers 18 and 36 have to be illuminated in identical ways, and light collected by fibers 20 and 38 has to be spectrally resolved, detected, and processed in identical ways. This can be achieved (not shown) by doubling elements 12, 14, 16 and 22, 24, 26 with elements 12′, 14′, 16′ and 22′, 24′, 26′; and by replacing elements 32, 34 with 12′, 14′, 16′ and elements 40, 42 with 22′, 24′, 26′ so that both illumination fibers 18 and 36 and both detection fibers 20 and 38 are equipped with identical sets of hardware. Electronics 28 contains control circuitry to modulate light sources 14 and 14′, e.g., by turning them on and off in alternating sequence. Marbach at 15:38-49.

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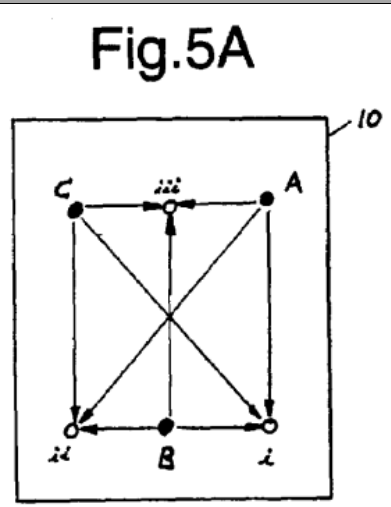
’304 Patent	Marbach
	 Fig.2 Marbach at Fig. 2. The fact that illumination and pickup optics are confocal, and the coherent detection afforded by the interferometer, cause the reflected light to be preferably detected from point 74, i.e., the effective measurement cuvette through sample 8 is more or less given by a single scatter-event path: straight in, backscattered at point 74, and straight back out. Marbach at 17:46-55. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

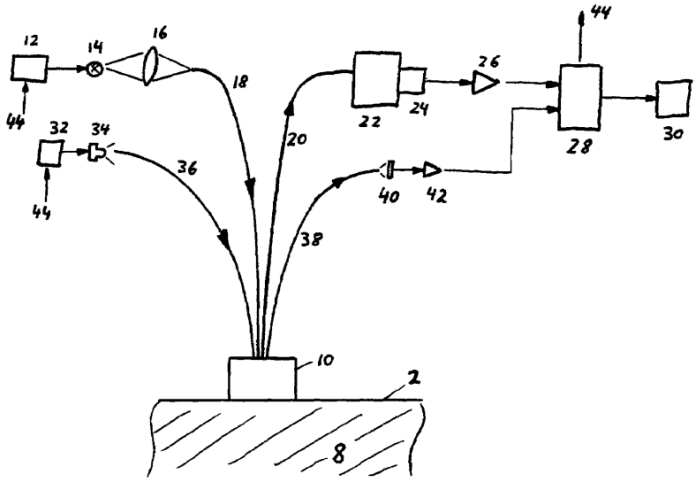
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11[j]. wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal;	Marbach discloses or renders obvious wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal. Thus, all surface instabilities and all instabilities of light emission and detection are ratioed out, and the result R is dependent only on the optical properties of the deeper layers of the sample. Since the properties of the deeper layers are usually more stable than those at the surface, the accuracy a.k.a. SNRX of the measurement is usually improved. Marbach at 8:27-32. In summary, the probe schematically shown in FIG. 1E can accurately measure spectral differences in absorbance coefficient. It is also a first example showing how spectrally-multivariate data (two different wavelengths) can be combined with geometrically-multivariate data (four different measurement beams) to increase the overall accuracy a.k.a. SNRX of the measurement. This last statement prepares the ground for explaining the fundamental, and so far unrecognized, SNRX-advantage of multi-beam probes. All advantages mentioned so far stem from this one, fundamental advantage. Marbach at 11:57-67.  Fig.1E Marbach at Fig. 1E.

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	Synchronous detection, e.g., using alternating pulses from light source 14 and LED 34 and gated amplifiers, or frequency modulation and lock-in amplifiers, is preferred and can be achieved by having electronics 28 provide timing signals 44 to drivers 12 and 32. LED 34 is preferably selected to emit light at a wavelength λLED that is close to, or within, the wavelength range of interest in order to maximize the correlation between the instabilities experienced by the different optical beams. Electronics 28 computes the explicit-ratio diffuse reflection spectrum at each wavelength, λi, resolved by spectrograph 22 as follows: Marbach at 14:62-15:6. If r-accuracy is required, then fibers 18 and 36 have to be illuminated in identical ways, and light collected by fibers 20 and 38 has to be spectrally resolved, detected, and processed in identical ways. This can be achieved (not shown) by doubling elements 12, 14, 16 and 22, 24, 26 with elements 12′, 14′, 16′ and 22′, 24′, 26′; and by replacing elements 32, 34 with 12′, 14′, 16′ and elements 40, 42 with 22′, 24′, 26′ so that both illumination fibers 18 and 36 and both detection fibers 20 and 38 are equipped with identical sets of hardware. Electronics 28 contains control circuitry to modulate light sources 14 and 14′, e.g., by turning them on and off in alternating sequence. Marbach at 15:38-49. The LEDs are preferably pulse-modulated with a pulse frequency on the order of several kHz. Low power, quasi-continuous operation is possible by measuring intermittently, e.g., one measurement lasting 10 seconds every 5 minutes. Battery operation is possible in many applications and solar cell powering is possible in some, depending on the sampling rate and SNRX requirements of the particular application. Marbach at 17:1-8. Best tracking is achieved when probing the skin at a depth of about 150 microns, because a dense network of capillaries is located at this depth (so-called venous plexus). Probing at other depths will yield concentration values that are relatively less well tracking with the concentration in the blood, i.e., information about the overall skin tracking error is embedded in the differences between the concentrations at different depths. Higher-order probes can use this information to improve the accuracy a.k.a. SNRX of the measurement, by subtracting out tracking-noise in the same way that the differences

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	between mutually-referencing beams are used to cancel out surface noise, viz., by applying the Wiener-filter method of signal-processing (see below) to the output data of the higher-order probe. Marbach at 19:9-22. The advantage of the Wiener filter method is that the overall measurement accuracy a.k.a. SNRX is optimized considering all types of measurement noises, including surface noise. Even though the Wiener filter may not get rid of 100% of the surface noise, it effectively cancels out all that surface noise that is in the way of measurement accuracy, keeping only that (small) part of the surface noise that happens to be in a data subspace with significant useful signal. For example, in the case of a 2×2 probe used in an application with dominant surface noise, the Wiener filter will be practically identical to the explicit-ratio result, Eq.(3). Depending on the details of the other noises affecting the measurement and their relative strength compared to the surface noise, there will be slight deviations, e.g., instead of the exact explicit-ratio filter, k·[+1−1−1+1]T (using vector notation), the Wiener filter may be, b=k·[+1.01−0.96−1.03+0.99]T, giving an output, Marbach at 20:43-59. An advantage of the Wiener filter method is that it seamlessly integrates multivariate data of different kinds into a single, optimal solution in a relatively straightforward way. Continuing the previous example, if the 3×3 probe of FIG. 5A is used for a spectroscopically resolved measurement of the scatter coefficient of human dermis, which then is used to predict the glucose concentration in blood, then the Wiener filter will automatically: cancel surface noise between beams, cancel spectrally interfering noise between wavelengths, and cancel tracking noise by locking in on differences in the skin glucose at different depths. Marbach at 21:18-28.

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	 Marbach at Fig. 5. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[k] a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive	Marbach discloses or renders obvious a smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link. From a hardware point-of-view, stability is often significantly easier to achieve than r-accuracy. Consider FIG. 2, showing a preferred embodiment of an optical diffuse reflection measurement system utilizing the basic 2×2 probe geometry of, e.g., FIG. 1B. An electrical driver 12 powers a light source 14 emitting

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and process at least a portion of the output signal, to store and display the processed output signal, and to transmit a portion of the processed output signal over a wireless transmission link; and	broad-band radiation covering the whole wavelength range of interest, which is collected by a lens 16 and guided through a fiber 18 to sample 8. The distal end of fiber 18 touches surface 2 of sample 8 and is therefore identical to entrance point A (not shown). Exit point ii (not shown) is formed in a similar way by the distal end of a pickup fiber 20. Fiber 20 guides the collected light to a spectrograph 22, where the light is spectrally dispersed and detected by a photodetector array 24. The electrical output signal of array 24 is amplified by a pre-amplifier 26 and fed into an electronic circuit 28 typically comprised of additional amplifiers, multiplexer, sample & hold, A/D converter, microprocessor or other digital signal processing hardware and software, and an optional user interface. Marbach at 14:28-46.  Fig.2 Marbach at Fig. 2. indicates a sum over one or more wavelengths emitted by LED 34 and detected by spectrograph 22. Electronics 28 then applies a calibration algorithm to spectrum R(λi), and then displays the measurement result on a display 30. Marbach at 15:23-26.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
11[l] a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	Marbach discloses or renders obvious a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12[pre] The measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions;	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Marbach discloses or renders obvious the measurement system of claim 11, wherein the measurement system is configured to use artificial intelligence in making decisions. *See* claim 11 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

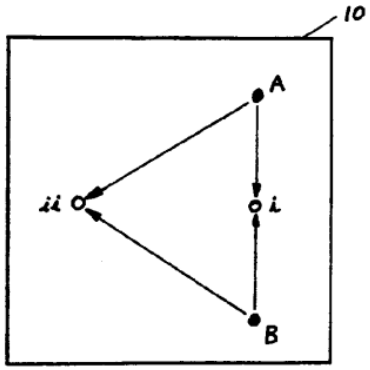
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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[a] wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set; and	Marbach discloses or renders obvious wherein the measurement system is configured to perform pattern identification or classification, and wherein the measurement system is configured to apply a threshold function to a comparison with a stored data set. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
12[b] wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques.	Marbach discloses or renders obvious wherein the measurement system is at least in part configured for selection or identification of an object, and wherein the measurement system is configured to improve a signal-to-noise ratio of the selection or identification by applying regression signal processing methodologies or multivariate techniques. In summary, the probe schematically shown in FIG. 1E can accurately measure spectral differences in absorbance coefficient. It is also a first example showing how spectrally-multivariate data (two different wavelengths) can be combined with geometrically-multivariate data (four different measurement beams) to increase the overall accuracy a.k.a. SNRX of the measurement. This last statement prepares the ground for explaining the fundamental, and so far unrecognized, SNRX-advantage of multi-beam probes. All advantages mentioned so far stem from this one, fundamental advantage. Marbach at 11:57-63. The fundamental advantage of multivariate over univariate measurements is that noise correlated between the different pieces of multivariate input data can be subtracted out in the measurement algorithm. The better the algorithm is at trading off, noise-subtraction versus signal-retention, the better the measurement accuracy a.k.a. SNRX will be. Accuracy is optimized when so-called multivariate Wiener filtering is used to process the multivariate input data into the single, user-desired output.

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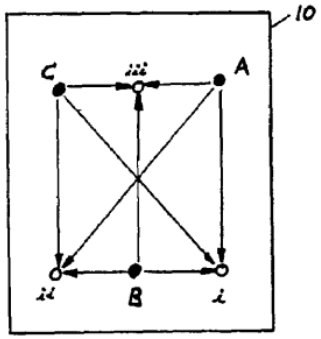
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	Marbach at 12:19-27. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 13	
13. The measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	Marbach discloses or renders obvious the measurement system of claim 12, wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claim 12 above. Thus, all surface instabilities and all instabilities of light emission and detection are ratioed out, and the result R is dependent only on the optical properties of the deeper layers of the sample. Since the properties of the deeper layers are usually more stable than those at the surface, the accuracy a.k.a. SNRX of the measurement is usually improved. Marbach at 8:27-32. In summary, the probe schematically shown in FIG. 1E can accurately measure spectral differences in absorbance coefficient. It is also a first example showing how spectrally-multivariate data (two different wavelengths) can be combined with geometrically-multivariate data (four different measurement beams) to increase the overall accuracy a.k.a. SNRX of the measurement. This last statement prepares the ground for explaining the fundamental, and so far unrecognized, SNRX-advantage of multi-beam probes. All advantages mentioned so far stem from this one, fundamental advantage. Marbach at 11:57-67.

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	 Fig.1E Marbach at Fig. 1E. Synchronous detection, e.g., using alternating pulses from light source 14 and LED 34 and gated amplifiers, or frequency modulation and lock-in amplifiers, is preferred and can be achieved by having electronics 28 provide timing signals 44 to drivers 12 and 32. LED 34 is preferably selected to emit light at a wavelength λLED that is close to, or within, the wavelength range of interest in order to maximize the correlation between the instabilities experienced by the different optical beams. Electronics 28 computes the explicit-ratio diffuse reflection spectrum at each wavelength, λi, resolved by spectrograph 22 as follows: Marbach at 14:62-15:6. If r-accuracy is required, then fibers 18 and 36 have to be illuminated in identical ways, and light collected by fibers 20 and 38 has to be spectrally resolved, detected, and processed in identical ways. This can be achieved (not shown) by doubling elements 12, 14, 16 and 22, 24, 26 with elements 12′, 14′, 16′ and 22′, 24′, 26′; and by replacing elements 32, 34 with 12′, 14′, 16′ and elements 40, 42 with 22′, 24′, 26′ so that both illumination fibers 18 and 36 and both detection fibers 20 and 38 are equipped with identical sets of hardware. Electronics 28 contains control circuitry to modulate light sources 14 and 14′, e.g., by turning them on and off in alternating sequence.

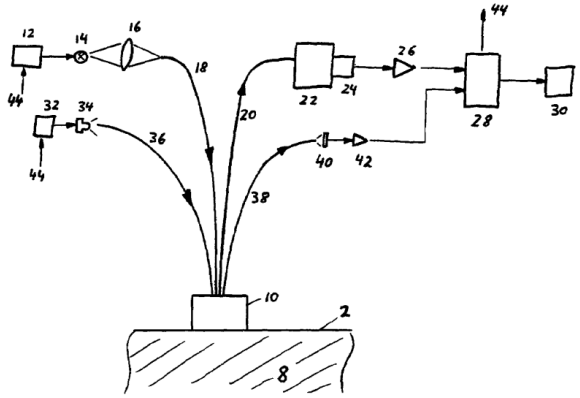
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	Marbach at 15:38-49. The LEDs are preferably pulse-modulated with a pulse frequency on the order of several kHz. Low power, quasi-continuous operation is possible by measuring intermittently, e.g., one measurement lasting 10 seconds every 5 minutes. Battery operation is possible in many applications and solar cell powering is possible in some, depending on the sampling rate and SNRX requirements of the particular application. Marbach at 17:1-8. Best tracking is achieved when probing the skin at a depth of about 150 microns, because a dense network of capillaries is located at this depth (so-called venous plexus). Probing at other depths will yield concentration values that are relatively less well tracking with the concentration in the blood, i.e., information about the overall skin tracking error is embedded in the differences between the concentrations at different depths. Higher-order probes can use this information to improve the accuracy a.k.a. SNRX of the measurement, by subtracting out tracking-noise in the same way that the differences between mutually-referencing beams are used to cancel out surface noise, viz., by applying the Wiener-filter method of signal-processing (see below) to the output data of the higher-order probe. Marbach at 19:9-22. The advantage of the Wiener filter method is that the overall measurement accuracy a.k.a. SNRX is optimized considering all types of measurement noises, including surface noise. Even though the Wiener filter may not get rid of 100% of the surface noise, it effectively cancels out all that surface noise that is in the way of measurement accuracy, keeping only that (small) part of the surface noise that happens to be in a data subspace with significant useful signal. For example, in the case of a 2×2 probe used in an application with dominant surface noise, the Wiener filter will be practically identical to the explicit-ratio result, Eq.(3). Depending on the details of the other noises affecting the measurement and their relative strength compared to the surface noise, there will be slight deviations, e.g., instead of the exact explicit-ratio filter, $k\cdot[+1-1-1+1]T$ (using vector notation), the Wiener filter may be, $b=k\cdot[+1.01-0.96-1.03+0.99]T$, giving an output, Marbach at 20:43-59.

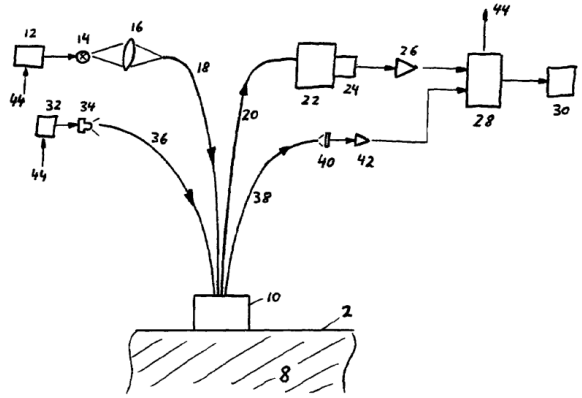
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	An advantage of the Wiener filter method is that it seamlessly integrates multivariate data of different kinds into a single, optimal solution in a relatively straightforward way. Continuing the previous example, if the 3×3 probe of FIG. 5A is used for a spectroscopically resolved measurement of the scatter coefficient of human dermis, which then is used to predict the glucose concentration in blood, then the Wiener filter will automatically: cancel surface noise between beams, cancel spectrally interfering noise between wavelengths, and cancel tracking noise by locking in on differences in the skin glucose at different depths. Marbach at 21:18-28. Fig.5A  Marbach at Fig. 5. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 14	

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14. The measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample.	Marbach discloses or renders obvious the measurement system of claim 11, wherein the plurality of semiconductor sources comprises at least one of: light emitting diodes (LEDs), laser diodes (LD's), tunable LD's, and super-luminescent laser diodes (SLDs), and the measurement system further comprising a reflective surface to receive and redirect at least some of the at least a portion of the analysis output beam reflected or transmitted from the sample. *See* claim 11 above. As a first and somewhat surprising example, assume that beams Bii and Bi are signal-redundant and that beams Aii and Ai are also made signal-redundant, e.g., by moving entry point A in FIG. 1B further to the left until the connection line A-B is orthogonal to connection line ii-i. The result of Eq.(3) is then, R≅1, which does not seem to be very interesting at first glance. However, the small deviation from the ideal R=1 is now a very reliable indicator of the spatial non-uniformities of bulk layer 6, and of bulk layer 6 only, i.e., unaffected by any non-uniformities of surface layer 4 or any surface noise for that matter. A practical application of this type of probe is a simple and rugged device for the detection of spatial non-uniformities in the human dermis, e.g., for skin cancer detection. A miniaturized, battery-powered probe of this kind can be built from, e.g., LEDs and Silicon photodiodes, and could be manually scanned across suspected skin areas. Marbach at 9:15-28. From a hardware point-of-view, stability is often significantly easier to achieve than r-accuracy. Consider FIG. 2, showing a preferred embodiment of an optical diffuse reflection measurement system utilizing the basic 2×2 probe geometry of, e.g., FIG. 1B. An electrical driver 12 powers a light source 14 emitting broad-band radiation covering the whole wavelength range of interest, which is collected by a lens 16 and guided through a fiber 18 to sample 8. The distal end of fiber 18 touches surface 2 of sample 8 and is therefore identical to entrance point A (not shown). Exit point ii (not shown) is formed in a similar way by the distal end of a pickup fiber 20. Fiber 20 guides the collected light to a spectrograph 22, where the light is spectrally dispersed and detected by a photodetector array 24. Marbach at 14:28-41.

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	 Fig.2 Marbach at Fig. 2. The confocality effect also applies to beam Bii, however, there will be no interference effects when detecting SBii because the interferometer is (with virtual certainty) far from zero-path difference with regard to this beam. Thus, detection of optical power SBii is not as concentrated around point 74 as is detection of SAii, and in general, SBii will be detected from shallower depth. By choosing wavelengths λSLED and λLED to be close to each other, surface instabilities are effectively canceled out. Marbach at 18:10-19. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15. The measurement system of claim 11, wherein the receiver comprises a	Marbach discloses or renders obvious the measurement system of claim 11, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.

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plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	*See* claim 11 above. As a first and somewhat surprising example, assume that beams Bii and Bi are signal-redundant and that beams Aii and Ai are also made signal-redundant, e.g., by moving entry point A in FIG. 1B further to the left until the connection line A-B is orthogonal to connection line ii-i. The result of Eq.(3) is then, R≅1, which does not seem to be very interesting at first glance. However, the small deviation from the ideal R=1 is now a very reliable indicator of the spatial non-uniformities of bulk layer 6, and of bulk layer 6 only, i.e., unaffected by any non-uniformities of surface layer 4 or any surface noise for that matter. A practical application of this type of probe is a simple and rugged device for the detection of spatial non-uniformities in the human dermis, e.g., for skin cancer detection. A miniaturized, battery-powered probe of this kind can be built from, e.g., LEDs and Silicon photodiodes, and could be manually scanned across suspected skin areas. Marbach at 9:15-28. From a hardware point-of-view, stability is often significantly easier to achieve than r-accuracy. Consider FIG. 2, showing a preferred embodiment of an optical diffuse reflection measurement system utilizing the basic 2×2 probe geometry of, e.g., FIG. 1B. An electrical driver 12 powers a light source 14 emitting broad-band radiation covering the whole wavelength range of interest, which is collected by a lens 16 and guided through a fiber 18 to sample 8. The distal end of fiber 18 touches surface 2 of sample 8 and is therefore identical to entrance point A (not shown). Exit point ii (not shown) is formed in a similar way by the distal end of a pickup fiber 20. Fiber 20 guides the collected light to a spectrograph 22, where the light is spectrally dispersed and detected by a photodetector array 24. Marbach at 14:28-41.

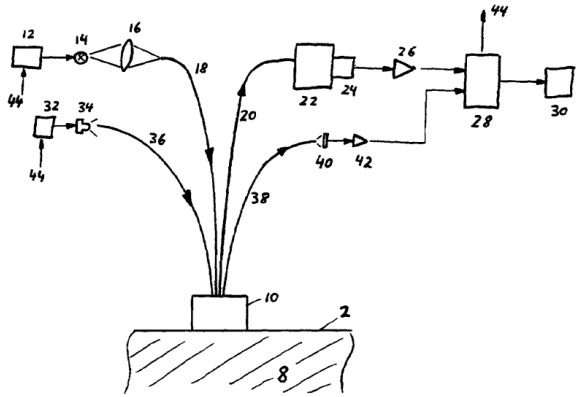
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	 Fig.2 Marbach at Fig. 2. Housing 10, which can be substantially circular in shape with a diameter preferably smaller than about 4 cm, is fixed with a bracelet 66 to sample 8, e.g., the wrist of the human arm, much like a watch. Marbach at 16:39-43. The confocality effect also applies to beam Bii, however, there will be no interference effects when detecting SBii because the interferometer is (with virtual certainty) far from zero-path difference with regard to this beam. Thus, detection of optical power SBii is not as concentrated around point 74 as is detection of SAii, and in general, SBii will be detected from shallower depth. By choosing wavelengths λSLED and λLED to be close to each other, surface instabilities are effectively canceled out. Marbach at 18:10-19. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it

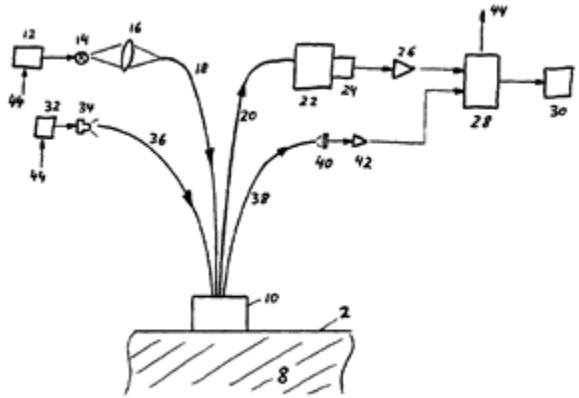
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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 16	
16. The measurement system of claim 15, wherein the first arc and the second arc are concentric.	Marbach discloses or renders obvious the measurement system of claim 15, wherein the first arc and the second arc are concentric. *See* claim 15 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 19	
19[pre] A wearable device for use with a smart phone or tablet, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Marbach discloses or renders obvious a wearable device for use with a smart phone or tablet, the wearable device. *See* 11[a], 11[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[a] a measurement device including a light source comprising a plurality of semiconductor sources for	Marbach discloses or renders obvious a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters. *See* 11[a].

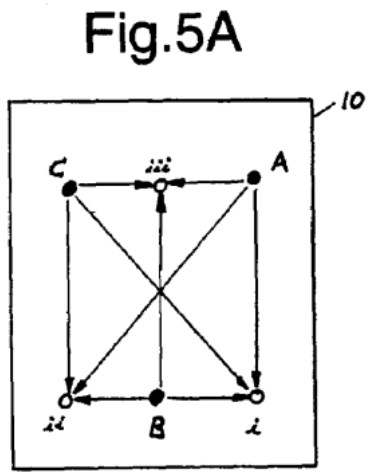
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measuring one or more physiological parameters,	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[b] the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths, and	Marbach discloses or renders obvious the measurement device configured to: generate, by modulating at least one of the semiconductor sources having an initial light intensity, an input optical beam having one or more optical wavelengths. As a first and somewhat surprising example, assume that beams Bii and Bi are signal-redundant and that beams Aii and Ai are also made signal-redundant, e.g., by moving entry point A in FIG. 1B further to the left until the connection line A-B is orthogonal to connection line ii-i. The result of Eq.(3) is then, R≅1, which does not seem to be very interesting at first glance. However, the small deviation from the ideal R=1 is now a very reliable indicator of the spatial non-uniformities of bulk layer 6, and of bulk layer 6 only, i.e., unaffected by any non-uniformities of surface layer 4 or any surface noise for that matter. A practical application of this type of probe is a simple and rugged device for the detection of spatial non-uniformities in the human dermis, e.g., for skin cancer detection. A miniaturized, battery-powered probe of this kind can be built from, e.g., LEDs and Silicon photodiodes, and could be manually scanned across suspected skin areas. Marbach at 9:15-28. The disclosed matter can thus be applied with significant benefit to a wide range of optical measurement applications. The most significant benefit is expected in two areas: (a) ill-posed measurements of small signals close to the hardware noise-floor, e.g., measurement of urea concentration in the interstitial fluid of human skin, and (b) well-posed measurements of large but spectrally-broad signals with SNRX-values that can not be sufficiently improved between wavelengths alone, e.g., measurements of changes in scatter coefficient or measurements that are affected by extraordinarily large amounts of surface noise, e.g., heart rate monitoring on exercising athletes.

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	Marbach at 13:1-12. From a hardware point-of-view, stability is often significantly easier to achieve than r-accuracy. Consider FIG. 2, showing a preferred embodiment of an optical diffuse reflection measurement system utilizing the basic 2×2 probe geometry of, e.g., FIG. 1B. An electrical driver 12 powers a light source 14 emitting broad-band radiation covering the whole wavelength range of interest, which is collected by a lens 16 and guided through a fiber 18 to sample 8. The distal end of fiber 18 touches surface 2 of sample 8 and is therefore identical to entrance point A (not shown). Exit point ii (not shown) is formed in a similar way by the distal end of a pickup fiber 20. Fiber 20 guides the collected light to a spectrograph 22, where the light is spectrally dispersed and detected by a photodetector array 24. Marbach at 14:28-41.  Fig.2 Marbach at Fig. 2. Synchronous detection, e.g., using alternating pulses from light source 14 and LED 34 and gated amplifiers, or frequency modulation and lock-in amplifiers, is preferred and can be achieved by having electronics 28 provide timing signals 44 to drivers 12 and 32. LED 34 is preferably selected to emit light at a wavelength λLED that is close to, or within, the wavelength range of interest in order to maximize the correlation between the instabilities experienced by the different optical beams. Electronics 28

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	computes the explicit-ratio diffuse reflection spectrum at each wavelength, λi, resolved by spectrograph 22 as follows: Marbach at 14:62-15:6. If r-accuracy is required, then fibers 18 and 36 have to be illuminated in identical ways, and light collected by fibers 20 and 38 has to be spectrally resolved, detected, and processed in identical ways. This can be achieved (not shown) by doubling elements 12, 14, 16 and 22, 24, 26 with elements 12′, 14′, 16′ and 22′, 24′, 26′; and by replacing elements 32, 34 with 12′, 14′, 16′ and elements 40, 42 with 22′, 24′, 26′ so that both illumination fibers 18 and 36 and both detection fibers 20 and 38 are equipped with identical sets of hardware. Electronics 28 contains control circuitry to modulate light sources 14 and 14′, e.g., by turning them on and off in alternating sequence. Marbach at 15:38-49.  Fig.2 Marbach at Fig. 2. The confocality effect also applies to beam Bii, however, there will be no interference effects when detecting SBii because the interferometer is (with virtual certainty) far from zero-path difference with regard to this beam. Thus, detection of optical power SBii is not as concentrated around point 74 as is

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	detection of SAii, and in general, SBii will be detected from shallower depth. By choosing wavelengths λSLED and λLED to be close to each other, surface instabilities are effectively canceled out. Marbach at 18:10-19. For example, in many industrial process-control applications the ability to measure the depth profile of moisture is important to fine-tune yield and quality of production processes, e.g., when making wooden boards or foodstuff. Another, particularly important biomedical application example is the measurement of the scattering coefficient, μS, of human skin as an indicator of the blood glucose concentration. It is known that the time profile of the glucose concentration in the skin is not perfectly correlated with the one in blood. One method that has been proposed to decrease the resulting so-called tracking error, is to make several consecutive skin measurements, say, at 10 minute intervals, then from these compute the rate of change in skin glucose concentration [(mg/dL)/minute], and then from the rate of change compute a correction factor to improve the accuracy of the current blood concentration measurement result. The point is, a depth-profile measurement at a single moment in time can be used to decrease tracking error in a similar way. Best tracking is achieved when probing the skin at a depth of about 150 microns, because a dense network of capillaries is located at this depth (so-called venous plexus). Probing at other depths will yield concentration values that are relatively less well tracking with the concentration in the blood, i.e., information about the overall skin tracking error is embedded in the differences between the concentrations at different depths. Higher-order probes can use this information to improve the accuracy a.k.a. SNRX of the measurement, by subtracting out tracking-noise in the same way that the differences between mutually-referencing beams are used to cancel out surface noise, viz., by applying the Wiener-filter method of signal-processing (see below) to the output data of the higher-order probe. Marbach at 18:58-19:22. An advantage of the Wiener filter method is that it seamlessly integrates multivariate data of different kinds into a single, optimal solution in a relatively straightforward way. Continuing the previous example, if the 3×3 probe of FIG. 5A is used for a spectroscopically resolved measurement of the scatter coefficient of human dermis, which then is used to predict the glucose concentration in blood, then the Wiener filter will automatically: cancel surface noise between beams, cancel spectrally interfering noise between wavelengths, and cancel tracking noise by locking in on differences in the skin glucose at different depths.

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	Marbach at 21:18-28.  Marbach at Fig. 5. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[c] receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue;	Marbach discloses or renders obvious the measurement device configured to receive and to deliver a portion of the input optical beam to tissue, wherein the tissue reflects at least a portion of the input optical beam delivered to the tissue. *See* 11[c], 11[e], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[d] the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue;	Marbach discloses or renders obvious the measurement device further comprising a receiver configured to: capture light while the semiconductor sources are off and convert the captured light into a first signal, and capture light while at least one of the semiconductor sources is on and convert the captured light into a second signal, the captured light including at least a portion of the input optical beam reflected from the tissue; *See* 11[d], 11[h], 11[i], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[e] synchronize to the modulation of the at least one of the semiconductor sources;	Marbach discloses or renders obvious the receiver configure to synchronize to the modulation of the at least one of the semiconductor sources. *See* 11[a], 11[b], 11[g], 19[a], 19[b], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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19[f] the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and	Marbach discloses or renders obvious the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal. *See* 11[b], 11[h], 11[i], 11[j], 19[a], 19[d]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[g] increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources;	Marbach discloses or renders obvious increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources. *See* 11[a], 11[b], 19[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[h] the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue;	Marbach discloses or renders obvious the measurement device further configured to generate an output signal representing at least in part a non-invasive measurement on blood contained within the tissue. *See* 19[a], 11[a], 11[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[i] the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen; and	Marbach discloses or renders obvious the wearable device configured to communicate with the smart phone or tablet, the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a voice input module, a speaker, and a touch screen. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
19[j] the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal, and transmit at least a portion of the processed output signal over a wireless transmission link.	Marbach discloses or renders obvious the smart phone or tablet configured to: receive and to process at least a portion of the output signal, store and display the processed output signal and transmit at least a portion of the processed output signal over a wireless transmission link. *See* 11[k], 19[pre]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 20	
20. The wearable device of claim 19, wherein the light	Marbach discloses or renders obvious the wearable device of claim 19, wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue

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source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate.	by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate. *See* claims 19, 13 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 21	
21. The wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	Marbach discloses or renders obvious the wearable device of claim 20, wherein the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc. *See* claims 15, 20 above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 22	
22. The wearable device of claim 21, wherein the first arc and the second arc are concentric.	Marbach discloses or renders obvious the wearable device of claim 21, wherein the first arc and the second arc are concentric. *See* claims 16, 21 above.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Marbach, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Marbach, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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