

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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APPLE INC.,  
Petitioner,

v.

MASIMO CORPORATION,  
Patent Owner.

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Case IPR2024-00294  
U.S. Patent 10,736,507

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**DECLARATION OF R. JAMES DUCKWORTH, PH.D.**

I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

I reserve the right to supplement my opinions in the future to respond to any arguments or positions Apple may raise, taking account of new information as it becomes available to me.

Dated: 3/27/2024

  
\_\_\_\_\_  
R. James Duckworth, Ph.D

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## **I. INTRODUCTION**

1. I, R. James Duckworth, Ph.D. have been retained by Knobbe, Martens, Olson & Bear, LLP, counsel for Petitioner Masimo Corporation (“Masimo”). I am making this declaration at the request of Masimo in the matters of *Inter Partes* for claims 1-20 of U.S. Patent No. 10,736,507 (“the ’507 Patent”). I understand that Masimo has asserted the ’507 patent against Petitioner in *Apple Inc. v. Masimo Corporation and Sound United, LLC*, U.S. District Court for the District of Delaware, Case No. 1:22-cv-01378-MN (“the Delaware Litigation”). I understand that this Declaration is being submitted as EX2002.

2. I am being compensated for my work in this matter at my standard hourly rate for expert consulting services. My compensation in no way depends on the outcome of this proceeding. I have no financial interest in any of the parties to these matters.

## **II. INFORMATION AND MATERIALS CONSIDERED**

3. I have been asked to provide technical expert opinions relating to the validity of the claims of the ’507 Patent. In conducting the analyses and forming the opinions set forth in this Declaration, I have reviewed and considered the ’507 Patent’s claims, specification, and file history. I have also reviewed and considered Apple’s petition for IPR2024-00294 (“the Petition”), the prior art references that

Apple relies on, the declarations of Dr. Thomas Kenny (EX1003), and all other exhibits that Apple attached to the 294 Petition, including the following:

| <b>Exhibit No.</b> | <b>Description</b>                                                                                                                                                                                                                                                 |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1001               | U.S. Patent No. 10,736,507 (“the ’507 patent”)                                                                                                                                                                                                                     |
| 1002               | File History of U.S. Patent No. 10,736,507                                                                                                                                                                                                                         |
| 1003               | Declaration of Dr. Thomas Kenny                                                                                                                                                                                                                                    |
| 1004               | RESERVED                                                                                                                                                                                                                                                           |
| 1005               | U.S. Patent Application Pub. No. 2008/0004904 to Tran (“Tran”)                                                                                                                                                                                                     |
| 1006               | U.S. Patent No. 6,658,276 to Kianl et al. (“Kianl”) APPLE-1007                                                                                                                                                                                                     |
| 1007               | Lorenzo T. D’Angelo, et al., A Sensor Network to iPhone Interface Separating Continuous and Sporadic Processes in Mobile Telemedicine, 33rd Annual International Conference of the IEEE EMBS Boston, Massachusetts USA, August 30 - September 3, 2011 (“D’Angelo”) |
| 1008               | U.S. Patent No. 7,812,826 to Ording et al. (“Ording”)                                                                                                                                                                                                              |
| 1009               | U.S. Patent Application Pub. No. 2007/0093786 to Goldsmith et al. (“Goldsmith”)                                                                                                                                                                                    |
| 1010               | U.S. Patent Application Pub. No. 2010/0324387 to Moon et al. (“Moon”)                                                                                                                                                                                              |
| 1011               | Y. Mendelson, et al., A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring, Proceedings of the 28 <sup>th</sup> IEEE EMBS Annual International Conference New York City, USA, Aug 30-Sept 3, 2006                                             |
| 1012               | Declaration of June Munford                                                                                                                                                                                                                                        |
| 1013               | U.S. Patent No. 8,195,848 to Jones (“Jones”)                                                                                                                                                                                                                       |

| Exhibit No. | Description                                                                                                                                                                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1014        | Exemplary Infringement Claim Chart for the '507 patent from <i>Apple Inc. v. Masimo Corporation et al.</i> , Case No. 1-22-cv-01378 (D. Del. Oct. 20, 2022)                                                                                                                                                                                   |
| 1015        | Exemplary Infringement Claim Chart for the '911 patent from <i>Apple Inc. v. Masimo Corporation et al.</i> , Case No. 1-22-cv-01378 (D. Del. Oct. 20, 2022)                                                                                                                                                                                   |
| 1016-1059   | [RESERVED]                                                                                                                                                                                                                                                                                                                                    |
| 1060        | U.S. District Courts–Combined Civil and Criminal Federal Court Management Statistics (Sep. 30, 2023)   United States Courts (uscourts.gov), <a href="https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_distprofile0630.2023.pdf">https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_distprofile0630.2023.pdf</a> |
| 1061        | Memorandum, Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation (USPTO June 21, 2022) (“Director’s Guidance”)                                                                                                                                                                   |
| 1062        | Apple’s Complaint for Patent Infringement (Design), <i>Apple Inc., v Masimo Corporation, et al.</i> , Case No. 1-22-cv-01377 (D. Del. Oct. 20, 2022)                                                                                                                                                                                          |
| 1063        | Apple’s Complaint for Patent Infringement (Utility), <i>Apple Inc., v Masimo Corporation, et al.</i> , Case No. 1-22-cv-01378 (D. Del. Oct. 20, 2022)                                                                                                                                                                                         |
| 1064        | Defendant Masimo Corporation’s Answer to Complaint and Counterclaims, <i>Apple Inc., v Masimo Corporation, et al.</i> , Case No. 1-22-cv-01378 (D. Del. Dec. 12, 2022)                                                                                                                                                                        |
| 1065        | Order Granting Joint Motion to Amend the Case Schedule, <i>Apple Inc., v Masimo Corporation, et al.</i> , Case No. 1-22-cv-01378 (D. Del. Sep. 21, 2023)                                                                                                                                                                                      |
| 1066        | Stipulation by Apple Inc.                                                                                                                                                                                                                                                                                                                     |
| 1067        | Email Identifying Masimo’s District Court Invalidity Grounds (Nov. 16, 2023)                                                                                                                                                                                                                                                                  |
| 1068        | Excerpt of Apple’s District Court Expert Invalidity Report, <i>Apple Inc., v Masimo Corporation, et al.</i> , Case No. 1-22-cv-01378 (Nov. 22, 2023)                                                                                                                                                                                          |
| 1069        | Order Granting Unopposed Motion to Stay Certain Patent Counterclaims, <i>Apple Inc., v Masimo Corporation, et al.</i> , Case No. 1-22-cv-01378 (Jan. 10, 2023)                                                                                                                                                                                |

4. I have also reviewed and considered at least the following materials in preparing this declaration.

| Exhibit No. | Description                                                                                                                    |
|-------------|--------------------------------------------------------------------------------------------------------------------------------|
| 2029        | Joint Claim Construction Briefing (August 31, 2023) in <i>Apple Inc. v. Masimo Corp et al.</i> , C.A. 22-1378-MN-JLH           |
| 2030        | Excerpts of the Transcript of the Deposition of Steven Warren in <i>Apple Inc. v. Masimo Corp et al.</i> , C.A. 22-1378-MN-JLH |
| 2031        | Excerpts of the Rebuttal Expert Report of Steven Warren in <i>Apple Inc. v. Masimo Corp et al.</i> , C.A. 22-1378-MN-JLH       |
| 2032        | Blood Oxygen App On Apple Watch, Apple (retrieved March 12, 2024)                                                              |
| 2033        | CC1100 Single Chip Low Cost Low Power RF Transceiver, Texas Instruments (June 20, 2006)                                        |

To the extent not listed above, I have also reviewed any other materials I discuss or cite herein. In preparing this Declaration, I have considered my own knowledge and experience, including my work in the fields of electrical and computer engineering; my experience teaching within those subjects; my experience working with others involved in those fields; and the materials identified herein. I understand my analyses and opinions, including my review of any materials cited herein, should be made from the perspective of a person of ordinary skill in the art related to the '507 Patent at the relevant time (i.e., a "POSITA"). I understand the relevant time is September 20, 2012. Accordingly, my analyses and opinions are made from that

relevant perspective.<sup>1</sup> My testimony herein refers to the knowledge of a POSITA as of September 20, 2012, unless indicated otherwise.

5. Any figures appearing in this Declaration were prepared with the assistance of counsel and reflect my understanding of the '507 Patent and the materials discussed herein.

### **III. EXPERIENCE AND QUALIFICATIONS**

6. My qualifications are set forth in my curriculum vitae, a copy of which is included as Exhibit 2001. A summary of my qualifications follows:

7. My academic and professional background is in electrical and computer engineering. I obtained a Bachelor of Engineering degree in Electrical and Electronic Engineering from the University of Bradford, England and a Ph.D. Degree in Electrical and Electronic Engineering from the University of Nottingham, England. My Ph.D. thesis work concerned increasing the speed of data processing using multiple processing elements to complete computations in parallel and triggering computations based on the availability of data. After completing my

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<sup>1</sup> I understand that, in the Delaware litigation, Masimo has presented evidence that at least some claims of the '507 Patent are entitled to an August 31, 2011 priority date. I have not been asked to form an opinion as to whether the claims of the '507 Patent are entitled to a priority date earlier than September 20, 2012. However, I reserve the right to offer such an opinion at a later date. If the claims of the '507 were entitled to an August 31, 2011 priority date, it would not change my opinions regarding what the alleged prior fails to teach or suggest

Ph.D., I was a lecturer in the university's Computer Science Department for two years.

8. For more than 40 years, I have studied, designed, and worked in these fields. My experience includes over 35 years of teaching and research, including in the fields of pulse oximetry and other physiological monitoring technologies, low powered wireless sensor design, embedded system design, wearable technology, and indoor location tracking for first responders, among others.

9. I have been a professor of electrical and computer engineering at Worcester Polytechnic Institute ("WPI") for over 35 years. I joined WPI in January 1987 as an Assistant Professor of Electrical Engineering and was an Associate Professor of Electrical and Computer Engineering from July 1991 to June 2021. Presently, I am a Professor Emeritus of Electrical and Computer Engineering at WPI.

10. More recently, my research work has centered on Precision Personnel Location (PPL) for First Responders. This project started as a result of a tragic incident in Worcester in 1999, when six firefighters lost their lives in a warehouse fire. The overall goal of the PPL project is to protect the lives of emergency responders and to enhance their ability to accomplish their missions through research and development of systems for personnel location and tracking, movements, physiological and environment status monitoring, and command and control. The PPL project brought together diverse technical capabilities from other centers and

laboratories at WPI to address important problems for emergency responders, the most critical of which is precise location and path tracking for each person in a building.

11. From 2005 through 2008, I worked extensively with my colleague at WPI, Professor Yitzhak Mendelson, Ph.D., to research, publish papers about, design, and make, wearable pulse oximetry devices. As part of my work, in 2006, I authored “A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring” along with Professor Mendelson and our student Gary Comtois. This paper is Exhibit 1011 in Apple’s Petition in this IPR and is the primary reference for all of Apple’s grounds of invalidity. Gary Comtois was a Master of Science student at our University who completed his thesis under our direction on the subject of “Adaptive Noise Cancellation Utilizing Accelerometry to Reduce the Effects of Motion Artifact in Wearable Reflectance Mode Pulse Oximetry.” Also during these years our work was to develop new wearable pulse oximetry devices suitable for military use. We received funding from the USAMRMC (United States Army Medical Research and Development Command) on a multi-year project titled ‘Real-Time Troop Physiological Status Monitoring Systems Using a Common Wireless Network’.

12. In 2007, I formed a company with Professor Mendelson called Advanced Body Sensing to design and build small battery-powered wearable pulse

oximeter devices that could be mounted on the forehead with a strap. Our final device design allowed for a number of vital signs to be measured including oxygen saturation ( $\text{SpO}_2$ ) and heart rate (HR). Our device had the potential for use in combat casualty care, such as for remote triage, and by first responders. It was used as part of the PPL project and by the United States Air Force. Due to a change in direction by the principals of the company, Advanced Body Sensing was closed in 2014. My significant experience relating to pulse oximetry sensors and involving Professor Mendelson is discussed in more detail in Section VIII.A, below.

13. For over 30 years, I developed and taught courses at WPI relevant to the technology disclosed in the '507 Patent. The classes I developed and taught included associated laboratory exercises and projects, which I also developed. As reflected in my curriculum vitae (EX2001), I developed and taught at least the following relevant courses: (1) Microprocessor System Design; (2) Modeling and synthesis of digital system using Verilog and VHDL; (3) VHDL for Modeling and Synthesis; (4) Computer System Design; (5) Multi-processor and Distributed Systems; (6) Advanced Computer System Design; and (7) Advanced Digital System Design with FPGAs. All of these courses pertain to the technology disclosed in the '507 Patent. For example, the "Advanced Digital System Design with FPGAs" course required students to interface peripheral sensors such as a light sensor with

an analog-to-digital converter to read information from the sensors and a digital-to-analog converter to convert sensed data into waveforms for processing.

14. In the course of my work at WPI, I have advised hundreds of engineering students in B.S. and M.S. programs and advised or co-advised approximately ten Ph.D. students that have completed Ph.D. degrees.

15. Additionally, I have authored or co-authored dozens of technical papers in refereed journals and conference proceedings and given many conference presentations in the fields I have taught, researched, and worked.

16. Aside from my work at WPI, I have years of experience working with portable, battery powered sensors. During leave in approximately 2000 from WPI, I was the Vice President of Engineering for Adaptive Instruments. At Adaptive Instruments, I was responsible for designing and manufacturing a line of wireless industrial sensors for use in industrial process control. As a consultant, I helped program a small, battery powered device used to count the number of times an inhaler had been used. Also as a consultant, I helped design and program a wrist-worn device that reminded the user throughout the day of the medications that needed to be taken. My work on the wrist-worn device led to the patent I obtained on a “Low Power Infrared Communication System,” U.S. Patent No. 6,091,530.

17. In addition to U.S. Patent No. 6,091,530, I am a named co-inventor on several relevant patents, including:

- a. U.S. Patent No. 7,292,189, issued in 2007, titled “Methods and Apparatus for High Resolution Positioning”
- b. U.S. Patent No. 9,476,963, issued in 2016, titled “Search and Rescue Method and System”
- c. U.S. Patent No. 9,658,309, issued in 2017, titled “Precision Location Method and System”; and
- d. U.S. Patent No. 9,846,042, issued in 2017, titled “Gyroscope Assisted Scalable Visual Simultaneous Localization and Mapping.”

18. Above, I have provided a short summary of my education and experience that I believe is most relevant to the analyses and opinions I have expressed in this Declaration. A copy of my curriculum vitae, which describes in further detail my qualifications, responsibilities, employment history, honors, awards, professional associations, presentations, publications, and patents is included as Exhibit 2001.

#### **IV. APPLICABLE LEGAL STANDARDS**

19. I am an electrical and computer engineer by training and profession. The opinions I express in this Declaration involve the application of my knowledge and experience to the evaluation of the ’507 Patent and certain prior art to the ’507 Patent.

20. Although I have been involved as a technical expert in patent matters before, I am not an expert in patent law. Therefore, I have been advised of certain principles of patent law applicable in this matter, which I have used in arriving at my determinations and opinions. The paragraphs below express my understanding of the legal requirements I have used in forming my opinions.

**A. Claim Construction**

21. I understand that, in assessing the patentability of a patent claim, the Patent Office generally construes claim terms by giving them their ordinary and customary meaning, as they would have been understood by a POSITA at the time of the invention in view of the intrinsic record (patent specification and file history). However, I understand that the inventors may, in the patent specification, expressly define a claim term to have a meaning that differs from the term's ordinary and customary meaning. I also understand that the inventors may disavow or disclaim certain claim scope, thereby departing from the ordinary and customary meaning, when the intrinsic record demonstrates that a clear and unambiguous disavowal or disclaimer has occurred. I understand that extrinsic evidence, such as relevant technical literature and dictionaries, may be useful in ascertaining how a POSITA would have understood a claim term, but the intrinsic record is the primary source for determining the meaning of claim terms. For the purposes of this review, and to

the extent necessary, I have interpreted each claim term in accordance with the principles set forth in this paragraph.

22. I understand that the preamble of a claim is limiting where it supplies antecedent basis for a subsequent claim limitation.

**B. Anticipation**

23. It is my understanding that a claim is unpatentable as “anticipated” under 35 U.S.C. § 102 if a single prior art reference discloses every limitation of the claim, arranged as in the claim. I understand that a prior art reference does not anticipate a claim, however, when it discloses multiple, distinct teachings that a POSITA might somehow combine to achieve the claimed invention.

24. Applying these legal standards to Claims 1-20 of the ’507 Patent, I believe Claims 1-20 would not have been anticipated based on the grounds asserted by Apple in its petitions, as discussed below.

**C. Obviousness**

25. I understand that a claim is unpatentable as “obvious” under 35 U.S.C. § 103 if the claimed subject matter as a whole would have been obvious to a POSITA at the time of the invention. I also understand that an obviousness analysis takes into account the following factors, which are sometimes referred to as the *Graham* factors: (1) the scope and content of the prior art, (2) the differences between the claimed subject matter and the prior art, (3) the level of ordinary skill in the art at

the time of the invention, and (4) “objective indicia of non-obviousness,” also referred to as secondary considerations of non-obviousness. I understand that these objective indicia include considerations such as whether there was: (i) any unexpected result(s); (ii) skepticism of the invention; (iii) a teaching away from the invention; (iv) failure of others to find the solution(s) provided by the claimed invention; (v) copying by other companies; (vi) commercial success due to the merits of the claimed invention; (vii) praise by others for the invention; and (viii) a long-felt need in the industry for the claimed invention.

26. In determining the scope and content of the prior art, it is my understanding that a reference is considered appropriate prior art if it falls within the field of the inventor’s endeavor. In addition, a reference is appropriate prior art if it is reasonably pertinent to the particular problem with which the inventor was involved. A reference is reasonably pertinent if it logically would have commended itself to an inventor’s attention in considering his or her problem. If a reference relates to the same problem as the claimed invention, that supports use of the reference as prior art in an obviousness analysis.

27. To assess the differences between prior art and the claimed subject matter, it is my understanding that 35 U.S.C. § 103 requires the claimed invention to be considered as a whole. This “as a whole” assessment requires showing that a POSITA at the time of invention, confronted by the same problems as the inventor

and with no knowledge of the claimed invention, would have selected the elements from the prior art and combined them in the claimed manner.

28. It is my further understanding that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include: combining prior art elements according to known methods to yield predictable results; simple substitution of one known element for another to obtain predictable results; a predictable use of prior art elements according to their established functions; applying a known technique to a known device (method or product) ready for improvement to yield predictable results; choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and some teaching, suggestion, or motivation that would have led a POSITA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

29. I understand that the obviousness analysis must be performed from the perspective of a POSITA at the time of the alleged invention. I understand this requirement is to help avoid using impermissible hindsight in the analysis. I further understand that the claims of the patent-at-issue must not be used to provide a road map for obviousness; instead, the claims would have been obvious only if a POSITA, without knowledge of the patent-at-issue, would have been motivated to

combine the teachings of the prior art to arrive at the claimed invention and had a reasonable expectation of success in doing so.

30. I understand that an assessment of what a reference discloses or teaches—for purposes of an anticipation analysis or an obviousness analysis—must be conducted from the perspective of a POSITA at the time of the invention. In other words, a reference discloses or teaches a claim limitation if a POSITA would, at the relevant time, interpret the reference as expressly, implicitly, or inherently disclosing the claim limitation. I further understand that a reference does not need to use the exact language of the claim to disclose a claim limitation. I also understand that something is only “inherent in,” and therefore taught by, the prior art if it necessarily flows from the explicit disclosure of the prior art. I understand the fact that a certain result or characteristic may be present in the prior art is not sufficient to establish inherency.

31. I understand that the obviousness analysis also must show that the prior art, taken as a whole, enables a POSITA to make and use the claimed invention.

32. Applying these legal standards to Claims 1-20 of the '507 Patent, I believe Claims 1-20 would not have been obvious to a POSITA based on the ground asserted by Apple in its petitions, as discussed below.

**V. LEVEL OF ORDINARY SKILL IN THE RELEVANT ART**

33. The field of art relevant to the '507 Patent is devices and sensors for the non-invasive measurement of physiological parameters, such as oxygen saturation.

34. I understand that obviousness must be evaluated from the perspective of what would have been known or understood by a POSITA at the time of the invention. I have been informed by counsel and understand that the priority date of the '507 Patent is at least as early September 20, 2012, which is the earliest effective filing date of the patent. I also understand that Apple has not alleged that the '507 Patent is entitled to an effective filing date other than September 20, 2012.

35. In my opinion, a POSITA at the time of the '507 Patent would be a person with a working knowledge of physiological monitoring technologies and/or optical sensors used in physiological monitoring technologies. The person would have had a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, software, or optical technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information, or designing and using optical sensors or systems, including but not limited to physiological monitoring technologies. Alternatively, the person could have had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline.

36. I understand that Apple has proposed the following definition of a POSITA with respect to the '507 Patent:

[A] person of ordinary skill in the art as of the Critical Date of the '507 Patent (hereinafter a "POSITA") would have been a person with a working knowledge of physiological monitoring technologies. The person would have had at least a bachelor's degree in electrical engineering, mechanical engineering, biomedical engineering, computer engineering, physics, or a related field, and would have had at least two years of relevant work experience with physiological monitoring technologies and devices, including user interfaces and capture and processing of physiological information, or equivalents thereof. Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline to compensate for less related work experience in the same discipline or vice versa.

EX1003 13-14.

37. I disagree with Apple's proposed definition of a POSITA because it requires no coursework, training, or experience with optics or optical physiological sensors and focuses on general physiological monitoring rather than optical sensors. However, my opinions would not change if I were to apply Apple's definition of a POSITA.

38. I understand the capabilities of a POSITA as of September 2012. Indeed, I possessed those capabilities myself before, during, and after that time. As a professor of electrical and computer engineering for over three decades, I have taught many such POSITAs and understand the level of knowledge and skill that persons with such academic experience would have possessed in September 2012. Through my education and decades of experience, such as teaching relevant

engineering courses and working with Professor Yitzhak Mendelson in designing and developing pulse oximetry devices, I am familiar with what a POSITA would have understood in September 2012 and qualified to provide opinions from the perspective of a POSITA at the relevant time.

39. My opinions remain the same under both my own and Apple's definition of POSITA.

## **VI. CLAIM CONSTRUCTION**

40. I understand that Apple stated in the petition that “no claim terms need be construed to resolve issues of controversy in the present Petition.” Pet., 2-3. For purposes of this declaration, I apply the plain and ordinary meaning of the terms of the '507 Patent. However, I reserve the right to offer opinions on claim construction at a later date. Further, I understand that Apple took a contrary position in the Delaware Litigation and proposed claim constructions for five terms in the '507 Patent. I understand that the parties offered the following claim constructions in the Delaware Litigation.

41. I understand the proposed construction of the “mobile measurement” claim element for the parties to be:

| <b>Masimo's Proposed Construction</b>               | <b>Apple's Proposed Construction</b>              |
|-----------------------------------------------------|---------------------------------------------------|
| Preamble is not limiting;<br>No construction needed | Preamble is limiting; “measurement during motion” |

EX2029, 27-33.

42. I understand the proposed construction of the “one or more signals” claim element for the parties to be:

| <b>Masimo’s Proposed Construction</b> | <b>Apple’s Proposed Construction</b> |
|---------------------------------------|--------------------------------------|
| No construction needed                | raw detected signal(s)               |

EX2029, 34-39.

43. I understand the proposed construction of the “via a processing board ... receiving ... processing ... outputting” claim element for the parties to be:

| <b>Masimo’s Proposed Construction</b> | <b>Apple’s Proposed Construction</b>                                               |
|---------------------------------------|------------------------------------------------------------------------------------|
| No construction needed                | The same processing board performs the receiving, processing, and outputting steps |

EX2029, 46-52.

44. I understand the proposed construction of the “via an application ... generating ... displaying ... displaying” claim element for the parties to be:

| <b>Masimo’s Proposed Construction</b> | <b>Apple’s Proposed Construction</b>                                           |
|---------------------------------------|--------------------------------------------------------------------------------|
| No construction needed.               | the same application performs the generating, displaying, and displaying steps |

EX2029, 53-57.

45. I understand the parties proposed the following constructions of the “the processing board in data communication with the optical sensor and a mobile computing device including a display”:

| Masimo's Proposed Construction | Apple's Proposed Construction                                                                                                             |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| No construction needed.        | the processing board communicates data with—rather than is a part of—the optical sensor and a mobile computing device including a display |

EX2029, 40-45.

46. As explained below, in my opinion, none of the grounds in Apple's petition show that the claims are anticipated or obvious under Apple's proposed constructions of "mobile measurement" or "one or more signals."

## **VII. SUMMARY OF OPINIONS**

47. I have conducted analyses leading to the opinions expressed in this Declaration. To summarize those opinions, it is my conclusion, from a technical point of view, that Claims 1-20 of the '507 Patent would not have been anticipated or obvious to a POSITA based on the grounds asserted by Apple in its petitions.

48. Regarding IPR2024-00294, it is my opinion that:

- (Grounds 1A1-1I) Claims 1-20 of the '507 Patent would not have been anticipated by, or obvious to a POSITA, based on Mendelson, D'Angelo, Ording, Tran, Kianl, or Goldsmith; and
- (Grounds 2A-2I) Claims 1-20 would not have been obvious to a POSITA based on Mendelson, D'Angelo, Moon, Ording, Tran, Kianl, or Goldsmith.

49. Below, I provide the complete analyses supporting my opinions.

## **VIII. BACKGROUND OF THE TECHNOLOGY**

### **A. Pulse Oximetry**

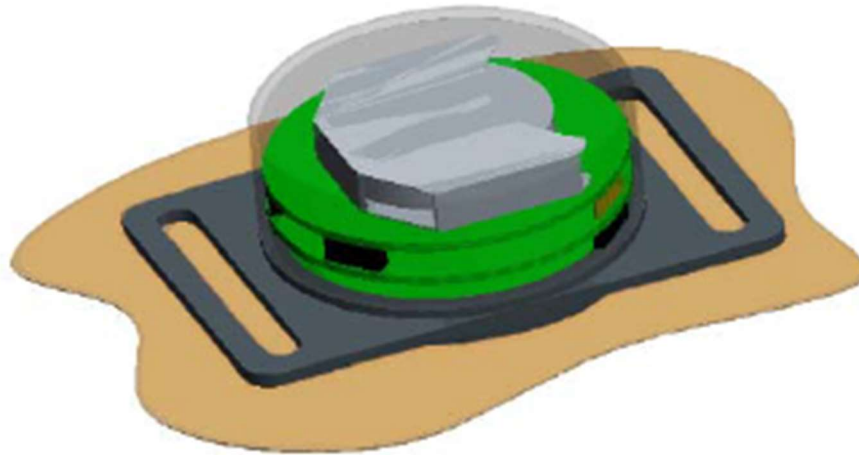
50. Pulse oximetry is a noninvasive method of measuring the arterial oxygen saturation of a patient's blood. Pulse oximeters typically emit light at two wavelengths, often red (approximately 600-700 nm) and infrared (approximately 800-950 nm). Red and infrared wavelengths are chosen because deoxyhemoglobin absorbs more light (i.e., has a higher optical extinction coefficient) than oxyhemoglobin in the red region of the spectrum, whereas oxyhemoglobin absorbs more light than deoxyhemoglobin in the infrared region of the spectrum.

51. The emitted red and infrared light enters into the user's tissue, where some of the light is absorbed by the blood or other tissue and some is not absorbed. The light that is not absorbed either passes through the tissue to a light detector on the opposite side of the tissue from where the light entered ("transmittance" pulse oximetry) or is reflected back to a light detector on the same side of the tissue from where the light entered ("reflectance" pulse oximetry). The light detector outputs what is known as a photoplethysmography (PPG) signal for each wavelength of received light—one PPG signal for red light, one PPG signal for infrared light. The amount of blood in the user's arteries changes as the heart beats (systole) and relaxes (diastole). The beating of the heart permits each PPG signal to be separated into (1) a pulsatile (or "AC") signal component that is caused by arterial blood and (2) a non-

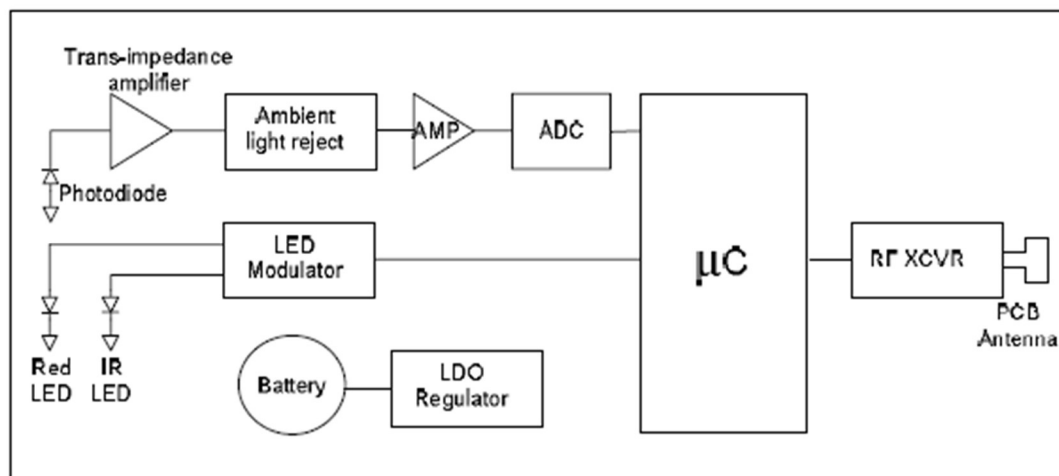
pulsatile (or “DC”) signal component that is primarily caused by bloodless tissue and residual blood when the heart is in diastole (i.e., venous blood). Complicated algorithms can then be used to calculate the ratio of AC/DC components for the red PPG signal divided by the ratio of AC/DC components for the infrared PPG signal—i.e., a ratio of ratios. This ratio of ratios can then be empirically mapped to an oxygen saturation value.

52. I understand the level of skill in the art at the relevant time very well, based on my work on pulse oximetry sensor design. From 2005 through 2008, I worked extensively with my colleague at WPI, Professor Yitzhak Mendelson, Ph.D., to research, publish papers about, design, and make, wearable pulse oximetry devices.

53. Around 2005-2006, I worked with Professor Mendelson to develop a prototype forehead-worn pulse oximeter and publish the findings from our work. One publication stemming from this work is titled “A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring,” and is Apple’s EX1011. As shown below, our prototype sensor design was a sensor with one photodiode, one red LED, and one infrared LED.



54.



55. *Id.*, 2. The sensor also includes a microcontroller and RF transceiver for transmitting packets to a receiving module. *Id.*, 2. We recognized at the time that, to become effective, a wearable pulse oximeter must be comfortable to wear. *Id.*, 1. At the ATA conference in 2006, we presented the results of our prototype sensor work.

56. Subsequently, in July 2007, Professor Mendelson and I formed a company together called Advanced Body Sensing to design, develop, and build a new, wireless, battery powered, forehead-mounted reflectance pulse oximetry device.

Together, Professor Mendelson and I (along with a few other engineers we hired) developed a new housing, optical sensor, and associated electronics, including the design and programming of microprocessor and wireless transmission components. Our design and development process led us to the final forehead-mounted pulse oximetry device shown below.

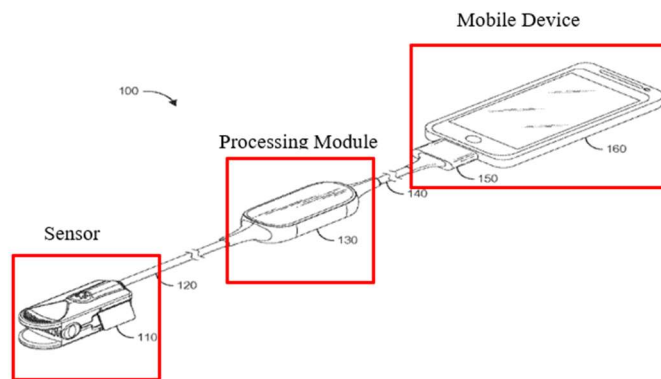


57. Our device included one red LED and one infrared LED (above, right), and a single photodetector (above, left). Over the course of 2007 and 2008, Advanced Body Sensing received approximately \$1,000,000 to develop and build the above pulse oximetry devices for the United States Air Force.

**B. Overview of the '507 Patent (EX1001)**

58. The '507 Patent is directed to a patient monitor that connects to mobile devices. EX1001, 1:20-25. In some embodiments, the patient monitor includes a sensor that connects to a processing module which then connects to a mobile device. *Id.*, FIG. 1A, 3:57-62, 4:65-5:14. The processing module receives signals from the

sensor, processes the signals, calculates measurement values, and then sends them to the mobile device. *Id.*, 4:65-5:14. The mobile device contains “software applications for managing the data and sensor.” *Id.*, 10:43-46. These applications display the measurement value on the mobile device and provide a user interface for the application. *Id.*, 10:35-46. Figure 1A shows this configuration:



*Id.*, FIG. 1A. The ’507 Patent explains that the processing module can comprise one or more processing boards within the module, such as an analog processing board and a digital processing board. *Id.*, FIG. 1C, 9:1-6, 9:62-65.

59. In my opinion, the claims of the ’507 Patent provide distinct advantages over the prior art. As described in the ’507 Patent, “[m]obility and ease of use are key factors in the health care industry because they correlate to efficient, rapid patient care as well as enable patients to participate in their own care.” EX1001 2:14-16. The claimed inventions allow for accurate measurements of SpO2 values outside of a hospital environment using a mobile device, in part by using a separate processing board. As the specification explains, a processing board can provide more accurate SpO2 measurement values to the mobile computing device, particularly when

compared to using the mobile computing device itself to compute the values. For example, the specification explains “the board or card can include one or more signal processors and associated memory, I/O, and the like to provide monitored physiological data to applications executing on traditional smartphone processing environments, such that board or card handles advanced signal processing and the smartphone displays parameter data.” *Id.*, 2:29-38; see also *id.*, 9:47-65. Using a dedicated processing board also improves power savings and decreases measurement latency when compared to using a processor on a mobile device. *Id.*, 6:38-7:2. This innovative system allows for more comprehensive patient care than was previously available, for example by allowing a patient’s blood oxygenation values to be continuously monitored to identify a risk of hypoxemia prior to a surgery. EX1001, 2:58-3:5.

**C. Apple’s Cited References**

**1. Mendelson (EX1011)**

60. The publication “A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring” authored by myself, Mendelson, and Comtois, discloses a pulse oximeter “for remote physiological monitoring.” EX1011, 1. The Mendelson system includes three components: (1) a “Sensor Module;” (2) a “Receiver Module;” and (3) a PDA. The “Sensor Module” generates sensor data and then wirelessly transmits packets of sensor data to the Receiver Module which conducts further

processing. *Id.*, 2. The Receiver Module transmits information to the PDA, which then generates displays based on the information for a user. *Id.*, 2-3.

## **2. D'Angelo (EX1007)**

61. D'Angelo is a conference paper allegedly published in September 2011. D'Angelo describes a system for interfacing sensor nodes and smartphones in a manner to allow for the logging of continuously measured data when a smartphone is not currently available. *See* EX1007, 2-3. D'Angelo does not discuss any particular sensor, and details only the use of a management device, that draws power from a smartphone.

## **3. Moon (EX1010)**

62. Moon is a December 23, 2010, publication of a patent application directed to a body-worn pulse oximeter. EX1010, 1. Moon describes a system including an oximetry probe and a wrist-worn transceiver, configured to monitor blood oxygenation, blood pressure, motion, posture, and activity level. *See* EX1010, Abstract.

## **4. Additional References**

63. Apple includes various additional combinations of references in order to allege the claims of the '507 Patent are obvious. These references include Goldsmith (EX1009), Ording (EX1008), Kianl (EX1006), and Tran (EX1005).

**IX. INDEPENDENT CLAIMS**

64. The below two tables include the limitations of the independent claims with associated labels corresponding to those used in Apple's Petition:

|               |                                                                                                                                                                                                                                            |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>[1pre]</b> | A mobile pulse oximetry system for informing a user of mobile measurement of oxygen saturation ("SpO2"), the computer-implemented method comprising:                                                                                       |
| <b>[1a]</b>   | an SpO2 measurement system including:                                                                                                                                                                                                      |
| <b>[1b]</b>   | an optical sensor configured to output one or more signals responsive to light from a light source attenuated by tissue of the user at a measurement site, said one or more signals responsive to an oxygen saturation of said tissue; and |
| <b>[1c]</b>   | a processing board in data communication with the optical sensor and a mobile computing device including a display and cellular communication, wherein the processing board is configured to:                                              |
| <b>[1d]</b>   | receive said one or more signals from the optical sensor;                                                                                                                                                                                  |
| <b>[1e]</b>   | process said one or more signals to generate SpO2 measurement values; and                                                                                                                                                                  |
| <b>[1f]</b>   | output the SpO2 measurement values to the mobile computing device; and                                                                                                                                                                     |
| <b>[1g]</b>   | one or more hardware processors of the mobile computing device configured to execute commands to:                                                                                                                                          |
| <b>[1h]</b>   | Generate a graphical user interface having a plurality of display portions;                                                                                                                                                                |
| <b>[1i]</b>   | display, in at least one portion of the plurality of display portions, a representation of a physiological parameter of a plurality of physiological parameters comprising at least the SpO2 measurement values; and                       |
| <b>[1j]</b>   | display, in a different portion of the plurality of display portions, a plurality of user inputs configured to allow the user to interact with at least one of the plurality of display portions or the application;                       |
| <b>[1k]</b>   | wherein the processing of the one or more signals to generate SpO2 measurement values is performed only on the processing board, thereby freeing up memory available to the mobile computing device; and                                   |

|             |                                                                                                          |
|-------------|----------------------------------------------------------------------------------------------------------|
| <b>[11]</b> | wherein the processing board is configured to draw power for operation from the mobile computing device. |
|-------------|----------------------------------------------------------------------------------------------------------|

EX1001 Claim 1.

|                |                                                                                                                                                                                                                                                                       |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>[13pre]</b> | A computer-implemented method of informing a user of mobile measurement of oxygen saturation (“SpO2”), the computer-implemented method comprising:                                                                                                                    |
| <b>[13a]</b>   | outputting, from an optical sensor of an SpO2 measurement system, one or more signals responsive to light from a light source attenuated by tissue of the user at a measurement site, said one or more signals responsive to an oxygen saturation of said tissue; and |
| <b>[13b]</b>   | via a processing board of the SpO2 measurement system, the processing board in data communication with the optical sensor and a mobile computing device including a display:                                                                                          |
| <b>[13c]</b>   | receiving said one or more signals from the optical sensor;                                                                                                                                                                                                           |
| <b>[13d]</b>   | processing said one or more signals to generate the SpO2 measurement values; and                                                                                                                                                                                      |
| <b>[13e]</b>   | outputting the SpO2 measurement values to the mobile computing device; and                                                                                                                                                                                            |
| <b>[13f]</b>   | via an application configured to execute commands on the mobile computing device:                                                                                                                                                                                     |
| <b>[13g]</b>   | generating a graphical user interface having a plurality of display portions;                                                                                                                                                                                         |
| <b>[13h]</b>   | displaying, in at least one portion of the plurality of display portions, a representation of a physiological parameter of a plurality of physiological parameters comprising at least the SpO2 measurement values; and                                               |
| <b>[13i]</b>   | displaying, in a different portion of the plurality of portions, a plurality of user inputs configured to allow the user to interact with at least one of the plurality of display portions or the application.                                                       |

EX1001 Claim 13.

## **X. ANALYSIS**

65. In my opinion, the IPR2024-00294 petition does not establish anticipation or obviousness of any of the claims of the '507 Patent. At this

preliminary stage I discuss certain problems with the petition's proposed anticipation and obviousness arguments but reserve the right to provide additional analysis and identify additional deficiencies.

66. Apple's asserted grounds are:

| <b>Ground</b> | <b>Claims</b>                | <b>§102</b>                        |
|---------------|------------------------------|------------------------------------|
| 1A1           | 13-15, 19                    | Mendelson                          |
| <b>Ground</b> | <b>Claims</b>                | <b>§103</b>                        |
| 1A2           | 13-15, 19                    | Mendelson                          |
| 1B            | 16, 18, 20                   | Mendelson, Tran                    |
| 1C            | 14, 17                       | Mendelson, Kianl                   |
| 1D            | 1, 2, 5, 7, 9, 12-15, 17, 19 | Mendelson, D'Angelo                |
| 1E            | 3                            | Mendelson, D'Angelo, Ording        |
| 1F            | 4-6, 8, 16, 18, 20           | Mendelson, D'Angelo, Tran          |
| 1G            | 2, 7, 14, 17                 | Mendelson, D'Angelo, Kianl         |
| 1H            | 3                            | Mendelson, D'Angelo, Kianl, Ording |
| 1I            | 10, 11                       | Mendelson, D'Angelo, Goldsmith     |
| 2A            | 13-15, 19                    | Mendelson, Moon                    |
| 2B            | 16, 18, 20                   | Mendelson, Moon, Tran              |
| 2C            | 14, 17                       | Mendelson, Moon, Kianl             |

|    |                                 |                                             |
|----|---------------------------------|---------------------------------------------|
| 2D | 1, 2, 5, 7, 9, 12-15, 17,<br>19 | Mendelson, Moon, D'Angelo                   |
| 2E | 3                               | Mendelson, Moon, D'Angelo, Ording           |
| 2F | 4-6, 8, 16, 18, 20              | Mendelson, Moon, D'Angelo, Tran             |
| 2G | 2, 7, 14, 17                    | Mendelson, Moon, D'Angelo, Kianl            |
| 2H | 3                               | Mendelson, Moon, D'Angelo, Kianl,<br>Ording |
| 2I | 10, 11                          | Mendelson, Moon, D'Angelo, Goldsmith        |

Pet., 1-2.

67. As discussed below in Section X(A), in my opinion Apple has not shown that the claims of the '507 Patent are anticipated or obvious under Apple's proposed Delaware claim constructions. In particular, in my opinion, Apple's arguments that its grounds disclose "one or more signals" or "mobile measurement" contradict Apple's positions in the Delaware litigation.

68. Additionally, as discussed in Section X(B), it is my opinion that Apple's grounds do not show that the claims of the '507 Patent are anticipated or obvious under any claim construction. In particular, Apple's Petition does not show that any art discloses a processing board "receiving one or more signals" as recited by the independent claims of the '507 Patent. Additionally, for Ground 1D and 2D, Apple has not shown that a POSITA would have been motivated to combine Mendelson's oximeter to draw power from a mobile device because this defeats the purpose of Mendelson's wearable physiological monitor.

**A. Apple Has Not Shown The Claims Of The '507 Patent Are Anticipated Or Obvious Under Apple's Proposed Delaware Constructions**

69. Apple's petition claims that "no express constructions are required" for any of the claim terms of the '507 Patent. Pet. 7-8. This contradicts Apple's position in the Delaware District Court, where Apple claimed that five claim terms required claim constructions. In my opinion, all of the grounds of Apple's petition fail to show that the claims of the '507 Patent are obvious or anticipated based on Apple's constructions.

**1. Mendelson Does Not Teach "One Or More Signals" Under Apple's Delaware Constructions**

70. I understand that Apple argues in all asserted grounds that the independent claims of the '507 Patent, claims 1 and 13, are anticipated by Mendelson, or obvious based on a combination of Mendelson, D'Angelo, and Moon. Apple has not demonstrated that these claims would have been anticipated by Mendelson, or obvious over the proposed combination. As all dependent claims of the '507 Patent rely on either claim 1 or 13, Apple has not demonstrated that any claim of the '507 Patent is obvious over any combination of the asserted art.

71. Claim 1 requires the processing board "receive said one or more signals from the optical sensor." For all grounds, Apple relies on Mendelson to disclose this limitation. In my opinion, Apple's arguments that Mendelson discloses this limitation contradict its positions in the Delaware Litigation.

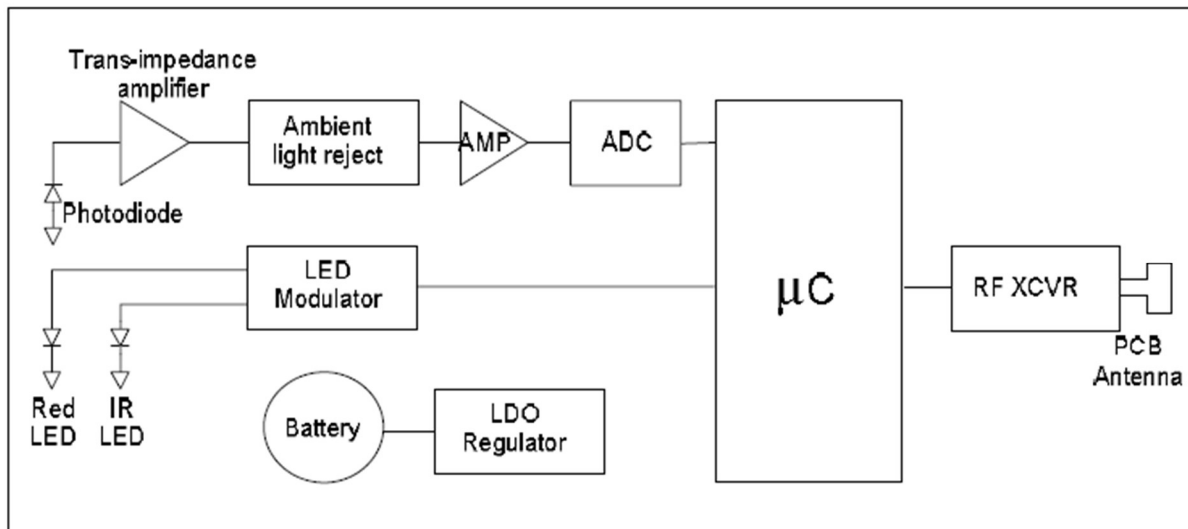
72. Claim 13 requires “a processing board of the SpO2 measurement system ... receiving said one or more signals from the optical sensor.” For all grounds, Apple relies on Mendelson to disclose this limitation. In my opinion, Apple’s arguments that Mendelson discloses this limitation contradict its positions in the Delaware Litigation.

73. It is my understanding that in the Delaware Litigation, Apple claimed “one or more signals” in the claims of the ‘507 Patent should be construed to mean “raw detected signal(s).” See EX2004 at 35-38. Apple claimed that “the claims make clear that the optical sensor detects signals, the optical sensor outputs those detected signals, and those detected signals are then received by the processing board.” EX2004 at 36. Apple then argued that the claims continue on to recite “the processing board then processes those detected signals and outputs SpO2 measurement values.” Thus, “[i]t *necessarily follows* that the detected signals received by the processing board—which are the same detected signals output from the optical sensor as evidenced by ‘said one or more signals’—are the unprocessed signals (i.e., raw signals).” *Id.* Apple also argued that the specification “confirms” this construction.

74. Despite arguing that the claims of the ’507 Patent necessitate this construction, Apple did not even address this construction in its petition. Indeed, Apple cannot show that Mendelson discloses transmitting “raw detected signal(s)” from its sensor to its processing board because such an argument would contradict its

positions in Delaware District Court. It is my understanding that Apple has argued that the Apple Watch does not infringe the '507 patent under its claim construction based on the same features also present in Mendelson. Specifically, Apple argued in the Delaware Litigation that the Apple Watch does not transmit “raw detected signal(s)” because a POSITA would understand such signals to be “raw signals as detected by a photodetector rather than signals that had been converted, amplified, filtered, or otherwise processed.” EX2031, 340-41.

75. In the petition, Apple argues that the “Sensor Module” of Mendelson is the “sensor” of all of the independent claims of the 507 Patent. Apple does not rely on any other prior art to teach this sensor element. Figure 2 of Mendelson, partially reproduced below, is a block system diagram of Mendelson’s Sensor Module.



EX1011, 2.

76. As shown in the figure, the Sensor Module comprises various components, including “analog signal processing circuitry,” and a photodiode used to receive light emitted by red and infrared LEDs after backscattering from skin tissue of a user. The signals generated by the photodiode in response to the received light are transmitted through a transimpedance amplifier, an “ambient light reject” component, an amplifier, an analog to digital converter (ADC), and finally to a microcontroller ( $\mu$ C). The sensor data output by the  $\mu$ C is provided as input to the RF transceiver for transmission to the Receiver Module. *Id.* The RF transceiver performs additional processing on the sensor data to generate packetized sensor data, which is then transmitted to the Receiver Module. *Id.*, 2-3. Indeed, in the system I constructed that the Mendelson paper describes, the microcontroller collects many samples of Red and IR data per second and stores these in the memory of the microcontroller. Approximately twice per second the microcontroller sends this collection of sensor data to the RF transceiver.

77. Accordingly, these components of Mendelson Sensor Module convert, filter, amplify and then process the sensor data generated by the photodiode to generate packetized sensor data for radio frequency transmission by the RF transceiver component. *See Id.*, 2. Thus, Apple arguments in the Delaware litigation contradict its positions here. Indeed, Apple’s own expert argued that signals cannot be “raw” signals under Apple’s Delaware construction if the signal passes through an

A/D converter. *See* EX2030, 249:12-16 (“a signal converted from an analog signal to a digital signal, via an A/D converter, is no longer a raw signal because that signal has been processed and sampled.”). He further testified that “when you change an analog signal into a digital signal, you change the nature of the signal; and you, therefore, process it.” *Id.*, 250:11-15. Mendelson’s sensor module includes an A/D converter that changes the analog signal to a digital signal before transmission. Thus, the signals received by the Receiver Module cannot be “raw detected signal(s)” under Apple own arguments.

**2. Mendelson Alone Or In Combination With Moon Does Not Teach “Mobile Measurement” Under Apple’s Delaware Constructions**

78. It is my understanding that in the Delaware Litigation, Apple argued that the preamble of independent Claim 13 was limiting and that the term “mobile measurement” in the preamble meant “measurement during motion.” EX2004 at 29, 33. The preamble of independent Claim 1 similarly recites “mobile measurement.” EX1001, Claim 1. Apple then argued that the Apple Watch does not infringe because the Apple Watch cannot measure pulse oximetry when the user is in motion. EX2031, ¶327.

79. I have reviewed Apple’s petition. For Grounds 1A-1I, Apple does not claim that any reference teaches measurement during motion. Pet., 64-65. Thus, in my opinion, Apple has not shown these references in these grounds anticipate or render obvious the claims under Apple’s construction of mobile measurement.

80. In Grounds 2A-I, Apple argues that Moon allegedly discloses “measurement through motion. *See* Pet., 64-72. I disagree.

81. Apple argues that the Moon reference discloses a pulse oximeter that “filter[s] the PPG and PTT waveforms using detected motion of the patient to more accurately determine SpO2.” Pet., 66 (citing EX1010, [0025], [0073]-[0074], [0089]-[0092]). Apple then claims that “[t]hese techniques allow for ‘motion [to] be detected and accounted for during pulse oximetry measurements to minimize the occurrence of false alarms and, additionally, make accurate readings in the presence of motion.’” Pet., 66 (citing EX1010, [0082], [0089]). In my opinion, however, Moon does not measure through motion. Instead, Moon declines to measure in the presence of too much motion.

82. The portions of Moon that Apple relies on make this clear. Moon explains that it uses motion sensors, such as an accelerometer, to determine how much the user is moving. EX1010, [0025], [0070], [0091]. For example, Moon discloses:

Typically only signals that are generated when motion is relatively low are considered in this embodiment. For example, signals are typically not processed further when the motion sensors indicate that motion is greater than an acceptable level. Filtering PTT values includes, for example, determining values that lie outside a pre-determined range using statistical filters (e.g. a simple average and standard deviation). More Sophisticated techniques, such as calculating a power value from

a frequency-domain spectrum corresponding to the time-dependent motion signal, and then comparing this to a pre-determined value, can be used to estimate if either the PTT values or PPG signals are affected by motion.

EX1010, [0025].

83. Moon further discloses that:

Once PTT is determined for each heartbeat in the measurement interval, a series of simple statistical filters are applied to detect pulses that may be corrupted by motion, and can thus potentially yield inaccurate values. .... If the PTT value for the immediate pulse is more than 1 STDEV greater than the AVE for the preceding  $\epsilon$  pulses, as shown in step 108, it is flagged as potentially originating from a IR(PPG) that is corrupted by motion.

EX1010, [0091].

84. In another example, Moon discloses:

If no more than an acceptable level of motion is present, as indicated by the ACC waveform, then the values for RED/IR(foot) and RED/IR(peak) can be processed to determine an RoR for each heartbeat.

EX1010, [0070].

85. If motion is present, Moon explains that its photodetector signals “are typically not processed further when the motion sensors indicate that motion is greater than an acceptable level,” as shown above. EX1010, [0025].

86. Similarly, Moon explains that its algorithm only proceeds to calculate SpO2 “[i]f the algorithm determines that no significant motion is present.” EX1010, [0073]. Moon also explains that “if motion was indeed present during a timer interval” and the motion “exceeded a pre-determined coefficient” then “the pulse is considered to be corrupted to an extent that neither PTT nor parameters associated with SpO2 (e.g. RED/IR (foot) and RED/IR(peak)) can be accurately measured.” EX1010, [0091]. For example, Moon states that:

If the algorithm determines that no significant motion is present (step 39), it proceeds to process the RED/IR(PPG) waveforms, starting at a time corresponding to the ECG QRS generated by a first heartbeat, and continuing the processing until a pre-determined time delta (e.g. 500 ms) or a time corresponding to a neighboring heartbeat is reached (step 41).

EX1010, [0073].

87. Thus, in my opinion, Moon does not disclose measuring through motion, but instead declining to measure if motion is present above a predetermined threshold.

88. In my opinion, Moon’s discussion of alarms confirms this. Apple relies on Moon’s disclosure that “knowledge of a patient’s motion, activity level, and posture can greatly enhance the accuracy of alarms/alerts generated by the body-worn monitor” to claim that Moon measures through motion. EX1010, [0015]. However, Moon continues on to explain that “a *walking patient typically yields noisy PPG*

*waveforms*, but also has a low probability of being hypoxic due to their activity state.

According to the invention, a patient in this condition thus *does not typically generate an alarm/alert, regardless of the value of SpO2 that is measured.*” EX1010, [0015].

89. For example, Moon states that:

As described therein, knowledge of a patient's motion, activity level, and posture can greatly enhance the accuracy of alarms/alerts generated by the body-worn monitor. For example, a walking patient typically yields noisy PPG waveforms, but also has a low probability of being hypoxic due to their activity state. According to the invention, a patient in this condition thus does not typically generate an alarm/alert, regardless of the value of SpO2 that is measured. Similarly, a patient that is convulsing or falling typically yields noisy RED/IR(PPG) waveforms from which it is difficult to extract an SpO2 value.

EX1010, [0015].

90. Therefore, in my opinion, Moon’s solution is to determine when motion is above an acceptable level, such as during walking, and then to suppress alarms because the SpO<sub>2</sub> measurements are unreliable.

91. It is my understanding that this is the same approach used by the Apple Watch, which Apple argues does not infringe the claims of the ‘507 Patent. Apple’s Delaware expert argued that the Apple Watch does not infringe because the Apple Watch does not measure through motion. EX2031, ¶327.

92. Apple’s own publicly released documentation states that “[m]otion and low blood perfusion can obscure the underlying heartbeat-induced pulsatile signals ... [t]o ensure accurate reporting, **the Blood Oxygen app withholds readings when it determines that the PPG signals from Apple Watch are inadequate or that positional or movement conditions are unsuitable for reliable SpO2 readings.**” EX2032 at 4. Thus, like Moon, the Apple Watch declines to measure SpO2 when too much motion is present.

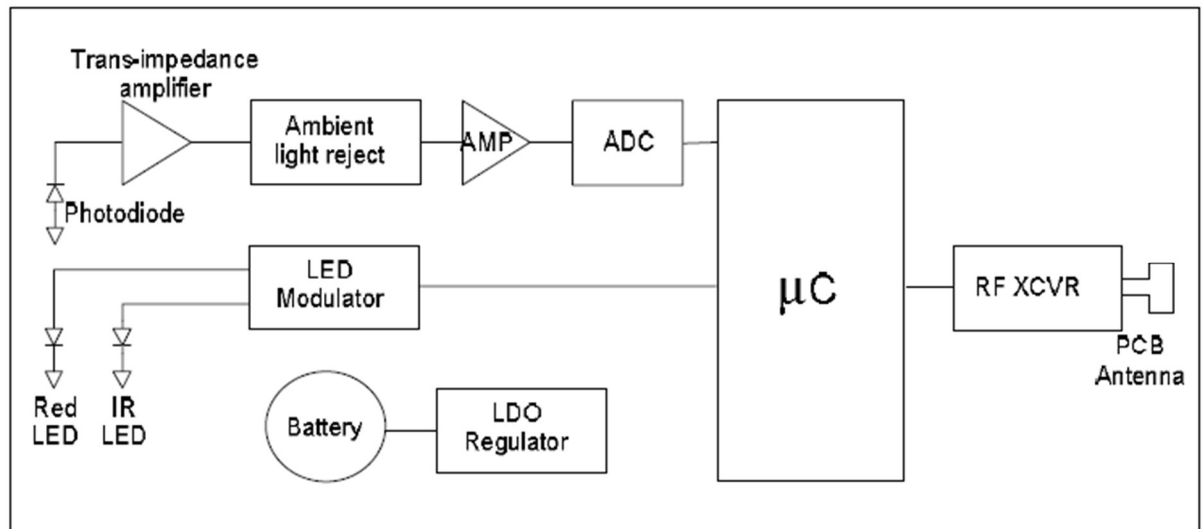
93. Therefore, in my opinion, Apple has not shown that any prior art meets Apple’s construction of “mobile measurement.”

**B. Apple Has Not Shown The Claims Of The ’507 Patent Are Anticipated Or Obvious Under Any Construction**

**1. Mendelson Does Not Disclose A Processing Board “receiving one or more signals”**

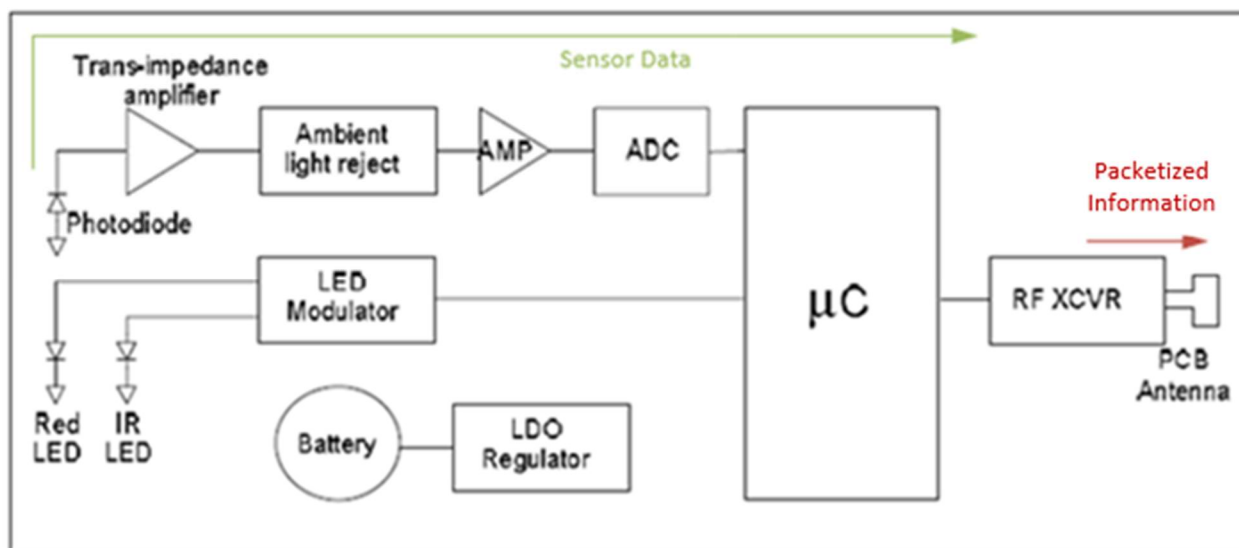
94. Independent Claim 1 of the ’507 Patent recites “an optical sensor” and a “processing board,” the “processing board configured to: receive one or more signals from the optical sensors.” Independent Claim 13 similarly recites “outputting, from an optical sensor . . . , one or more signals” and “via a processing board . . . receiving said one or more signals from the optical sensor.” In Apple’s petition, Apple relies on only Mendelson to teach these limitations. However, in my opinion, does not disclose a processing board receiving one or more signals from an optical sensor under the plain and ordinary meaning of one or more signals.

95. Apple’s Petition identifies the “Sensor Module” of Mendelson as the “optical sensor” of the independent claims of the ’507 Patent. Pet., 10-11. Exhibit 1011 Figure 2 displays a circuit diagram of this Sensor Module.



96. As displayed by the circuit diagram, the photodiode generates a signal that proceeds through a transimpedance amplifier, “ambient light reject” signal conditioning, an amplifier, and an analog to digital converter. The digital output of that converter then enters a microcontroller (marked  $\mu C$ ). After processing that output, the microcontroller sends a different digital output to an RF Transceiver (marked RF XCVR) to transmit information to the Receiver Module. EX1011, 2. Indeed, Mendelson states that “[t]he information acquired by the Sensor Module is transmitted wirelessly via an RF link over a short range to a body-worn Receiver Module.” *Id.*

97. A POSITA would understand that, because Mendelson uses an RF Transceiver to transmit information to the Receiver Module, the Sensor Module is sending RF packets to the Receiver Module. These packets would include time samples of data from red or infrared light received by a sensor, as well as other information such as packet headers and checksums. This is the normal and customary operation of a RF transceiver. I am one of the authors of Mendelson. When Mendelson refers to “information,” Mendelson refers to portions of digital data along with at least packet headers and checksums. Annotated Figure 2, displays how this operates, where the Sensor Data represents a signal generated by the photodiode in response to receiving either red or infrared light, and the Packetized Information includes a collection of many time samples of the Sensor Data as well as other information such as packet headers and checksums:



98. Indeed, I am one of the authors of the Mendelson paper, and a designed of the system described in EX1011, and I can confirm that the Mendelson device operated in exactly this way. The RF Transceiver of Mendelson is a Texas Instruments CC1100 Low-Power Sub- 1GHz RF Transceiver (“CC1100”), which is designed to packetize data before transmission. *See e.g.*, EX2033, 1-2, 31-35. The CC1100 “provides extensive hardware support for packet handling.” *Id.*, 1. These packets include a preamble, a sync word, length and address fields, a data field which contains the sensor data for the packet, and a checksum as shown in the figure below:

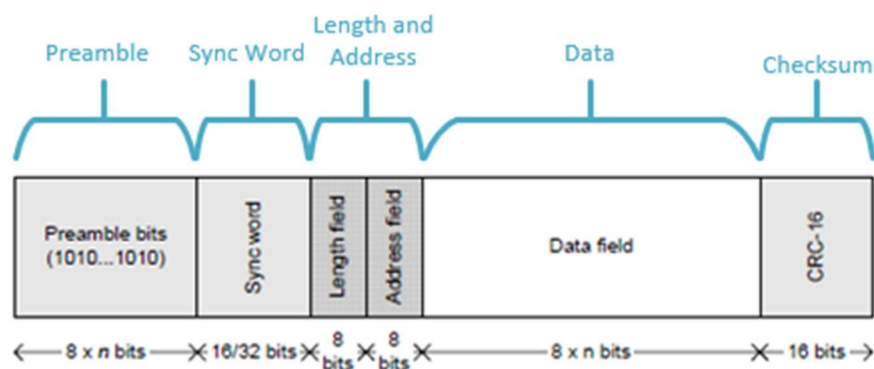


**Figure 11: Packet Format**

*Id.*, 32. For example, if signal data is generated by the photodiode every 10ms for one of the red or infrared LEDs, and packetized information is transmitted by the RF transceiver every 500ms, then 50 time intervals of red and infrared sensor data are transmitted in each packet. In the system I constructed that the Mendelson paper describes, the microcontroller collects many samples of Red and IR data per second and stores these in the memory of the microcontroller. Approximately twice per

second the microcontroller sends this collection of sensor data to the RF transceiver. The RF transceiver then includes these samples in the Sensor Data field of the packet.

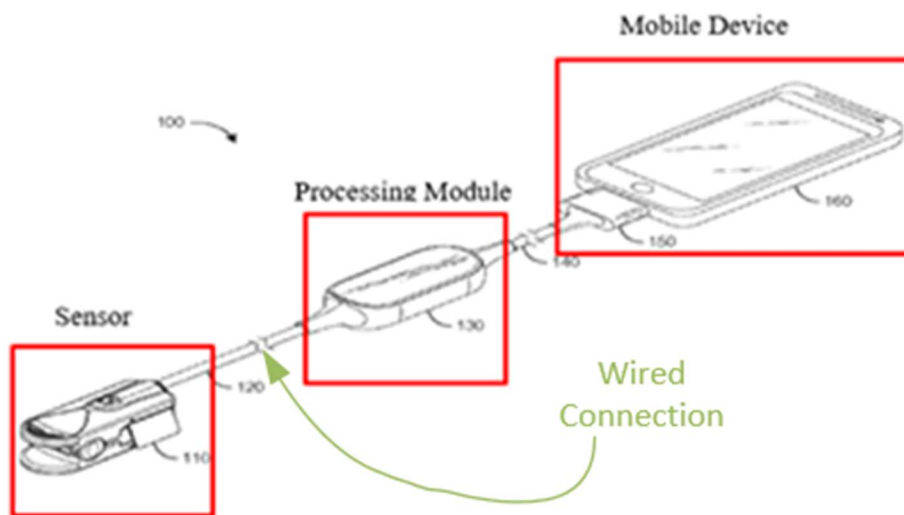
99. In my opinion, Mendelson describes a different structure than claimed in the '507 Patent because it discloses a microcontroller and transceiver on the sensor. Because of this difference in structure, we designed the Mendelson device to have three different power sources (1) the battery of the "Sensor Module", (2) the battery of the "Receiver Module;" and (3) the battery of the PDA.

100. A POSITA would understand that this packetized sensor data is not a "signal" under any construction of the term. Thus, the Receiver Module cannot be a processing board that that is "configured to: receive one or more signals from the optical sensors" (Claim 1), or a processing board "receiving said one or more signals from the optical sensor" (Claim 13). Indeed, unlike the 507 Patent, Mendelson's sensor includes a microcontroller that performs at least some operations before the "information" is passed to the disclosed transceiver. In my opinion, neither Apple or its expert explains why this information is a signal.

101. A POSITA would understand that the packet received by the Receiver Module is not a signal for at least two reasons. First, the packet contains packet specific information like a checksum or a packet header that a sensor signal would not contain. Second, a packet would contain multiple values derived from sensor data over a period of time. A sensor signal does not contain multiple values collected

over time. Further, Mendelson uses packets because it is a method for sending wireless information in a power efficient way, one of the goals of Mendelson, and was required to transmit the collected sensor data from the forehead mounted sensor module to the body worn receiver. EX1011, 1. Using wireless transmission also was required to transmit the collected sensor data from the forehead mounted sensor module to the physically separated body worn receiver module. In contrast, a sensor signal is often transmitted over a wired connection that allows more instantaneous transmission.

102. The disclosure of the '507 Patent confirms my understanding. The '507 Patent discloses that its sensor is connected to its processing module via a direct, wired, connection:



EX1001 FIG. 1 (annotated). The '507 Patent does not disclose transmitting data wirelessly from the sensor to the processing module. Accordingly, a POSITA would not consider Mendelson to disclose “an optical sensor” and a “processing board”

where “the processing board [is] configured to: receive one or more signals from the optical sensors” (Claim 1) or “outputting, from an optical sensor . . . , one or more signals” and “via a processing board . . . receiving said one or more signals from the optical sensor” (Claim 13).

103. Apple’s Petition argues that the statement “[t]he information acquired by the Sensor Module is transmitted wirelessly via an RF link over a short range to a body-worn Receiver Module” in Mendelson discloses “outputting, from an optical sensor of an SpO<sub>2</sub> measurement system, one or more signals.” Pet., 11. A POSITA would understand that when Mendelson says “the information” this refers to the packetized sensor data output by the RF transceiver, and does not refer to a “signal.” Therefore, the portion of Mendelson Apple cites to does not teach “outputting” one or more signals from the Sensor Module or receiving the one or more signals at the Receiver Module.

104. Apple also relies on Mendelson’s statement that “[s]ignals acquired by the Sensor Module are received by the embedded microcontroller [at the Receiver Module]” to argue that Mendelson discloses these limitations. I am one of the authors of this paper. Pet., 11. This sentence is referring to how the sensor data from the photodiode is then turned into packetized information, as explained above, before it is transmitted to the Receiver Module. In my opinion, outputting and receiving

packetized signal data is not outputting or receiving a signal. Accordingly, Apple does not show that Mendelson or any other cited art teaches this claim element.

2. **A POSITA Would Not Have Been Motivated To Combine Mendelson’s Oximeter To Draw Power From A Mobile Device As In D’Angelo Because This Defeats The Purpose Of Mendelson’s Remote Oximeter**

105. I understand that Apple does not argue that its primary reference, Mendelson, teaches the following limitation of Claim 1 of the ‘507 Patent: “is configured to draw power for operation from the mobile computing device.” *See* Pet., 42. Instead, Apple claims that D’Angelo teaches this limitation and that D’Angelo could be combined with Mendelson. *Id.*, 41-43. But, in my opinion, a POSITA would not be motivated to combine Mendelson with D’Angelo.

106. I understand that Apple claims D’Angelo teaches a management device that draws power from a smartphone in order to operate, and that this teaching of D’Angelo would motivate a POSITA to modify the Receiving Module of Mendelson to draw power from a smartphone. *See* Pet., 37-38.

107. However, in my opinion, a POSITA would not be motivated to modify Mendelson in this way, as such a modification would defeat the purpose of Mendelson’s design.

108. For example, Mendelson describes the “initial bench testing of a *wireless wearable* pulse oximeter.” EX1011, 1 (emphasis added). Mendelson continues that the impetus of this design was “development of compact, low-power,

small-size, light- weight, and unobtrusive **wearable** devices” based on advancements in “physiological sensing, hardware miniaturization, and **wireless communication**.”

*Id.* Mendelson further explains that these advances allow for “[t]elemetry of physiological information via a short-range wirelessly-linked personal area network.”

*Id.* As an author of Mendelson, I can confirm that such a design would be useful “for firefighters, hazardous material workers, mountain climbers, or emergency first-responders operating in harsh and hazardous environments,” as stated in Mendelson.

*Id.* Indeed, the Mendelson paper further states that

Having wearable physiological monitoring could offer far-forward medics numerous advantages, including the ability to determine a casualty’s condition remotely without exposing the first responders to increased risks, quickly identifying the severity of injuries especially when the injured are greatly dispersed over large geographical terrains and often out-of-site, and continuously tracking the injured condition until they arrive safely at a medical care facility.

*Id.*, 1.

109. Mendelson describes the use of a “Receiver Module” that communicates via “bi-directional wireless communications” with a PDA. *Id.*, 2. Mendelson also describes that the authors chose a specific PDA in its design because “it can support both 802.11b and Bluetooth™ wireless communication.” *Id.*, 3. As an author of Mendelson, I can confirm this was a reason the Hp iPAQ h4150 was selected. The PDA provides a GUI that allows it to monitor “multiple wearable devices” at the same time. *Id.*

110. Mendelson also explains that the Receiver Module’s wireless design “allows the PDA to communicate with a remote unit that is beyond the PDA’s wireless range. The ad-hoc network would therefore allow medical personnel to quickly distribute sensors to multiple casualties and begin immediate triage, thereby substantially simplifying and reducing deployment time.” *Id.* Further Mendelson explains that the authors spent significant time on “lowering the power consumption” to allow for a wearable wireless pulse oximeter. *Id.*, 3-4. As one of the authors of Mendelson, I can confirm we did spend significant time working to lower the power consumption of the pulse oximeter to allow the device to be wearable and wireless.

111. In my opinion, modifying the Receiver Module to require it to draw power from the PDA, instead of a battery, would defeat the purpose of the Mendelson design. Such a change would prevent the Receiver Module from being wearable and prevent the PDA from connecting to multiple receiver modules at the same time. Further, such a change would vitiate the efforts that we, the Mendelson authors, spent on reducing the power consumption of the Receiver Module to allow it to be a wearable device that can transmit information wirelessly.

112. Indeed, as one of the authors of Mendelson, I can confirm that neither I nor the rest of the team working on the Mendelson design would have ever changed the Receiver Module to draw power from a wired connection to the PDA because it would have defeated the purpose of the overall system design. *See Id.*, 1. As

described in our paper, I and the other Mendelson authors deliberately designed a battery powered Receiver Module that connected wirelessly to a PDA. *See Id.*, 3. This allowed the system described by the Mendelson reference to meet the design goals of making the Receiver Module wearable and allowing the PDA to connect to many Receiver Modules at once to form an ad-hoc network to assist “emergency medical teams in remote triage operations”. *Id.*, 1, 3.

113. Therefore, in my opinion, a POSITA would not have been motivated to modify Mendelson as described in Apple’s petition. Indeed, I am a POSITA and an author of Mendelson, and I would not have been motivated to modify the design to include a wired connection between the Receiver Module and the PDA of the Mendelson design.

**C. Dependent Claims Of The ‘507 Patent Are Valid**

114. Each of the dependent claims of the ‘507 Patent depends, directly or indirectly, on one of the independent claims 1 or 13. As discussed above, it is my opinion that the art cited by Apple fails to render each of Claims 1 and 13 invalid for anticipation or obviousness.

115. Therefore, in my opinion, each of the ‘507 Patent’s dependent claims is also valid.

## **XI. CONCLUSION**

116. For these reasons, it is my opinion that each of Claims 1-20 of the '507 Patent would not have been obvious to a person of ordinary skill in the art. For the reasons I have explained, Apple's IPR2024-00294 petition does not show that any of the challenged claims of the '507 Patent would have been obvious to a POSITA at the relevant time in September, 2012.