

[Public Version]

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,

Petitioner,

v.

MASIMO CORPORATION,

Patent Owner.

Case IPR2024-00243  
U.S. Patent 10,722,159

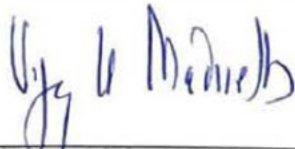
**DECLARATION OF VIJAY K. MADISETTI**

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.

Date:

11/3/2024

  
\_\_\_\_\_  
Vijay K. Madiseti, Ph.D.

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I, Vijay K. Madisetti, declare as follows:

1. My name is Vijay K. Madisetti. I have been retained by Knobbe, Martens, Olson & Bear, LLP, counsel for Patent Owner Masimo Corporation (“Masimo”) as an independent expert witness in this proceeding. I am making this declaration at the request of Masimo in the matter IPR2024-00243, which concerns certain claims of U.S. Patent No. 10,722,159.

2. I have also been retained by Knobbe, Martens, Olson & Bear, LLP, counsel for Masimo Corporation in the cases *Apple, Inc. v. Masimo Corp. et al.*, Nos. 22-1377-MN-JLH and 22-1378-MN-JLH, pending before the U.S. District Court for the District of Delaware (collectively, the “Delaware Litigation”). In the Delaware Litigation, I also presented opinions concerning Apple’s infringement of the ’159 Patent and the validity of the ’159 Patent. I was also previously retained by Knobbe, Martens, Olson & Bear, LLP, counsel for Masimo Corporation, in the ITC Investigation *Certain Light-Based Physiological Measurement Devices and Components Thereof*, Inv. No. 337-TA-1276 (“ITC Investigation”). In the ITC Investigation, I also presented opinions concerning Apple’s infringement of a related U.S. Patent No. 10,687,745 (“’745 Patent”) and the validity of the ’745 Patent, including based on the same prior art references that are applied in this IPR.

3. I am being compensated by Masimo for my work in this matter at my standard hourly rate for expert consulting services. My compensation is in no way dependent on the outcome of this proceeding.

### **I. QUALIFICATIONS**

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

5. I obtained my Ph.D. in Electrical Engineering and Computer Science at the University of California, Berkeley, in 1989. While there, I received the Demetri Angelakos Outstanding Graduate Student Award and the IEEE/ACM Ira M. Kay Memorial Paper Prize.

6. I joined Georgia Tech in the Fall of 1989 and am now a tenured full professor in Electrical and Computer Engineering and more recently in the College of Computing. Among other things, I have been active in the areas of digital signal processing, wireless communications, integrated circuit design (analog & digital), system-level design methodologies and tools, and software engineering. I have been the principal investigator (“PI”) or co-PI in several active research programs in these areas, including DARPA’s Rapid Prototyping of Application Specific Signal Processors, the State of Georgia’s Yamacraw Initiative, the United States Army’s Federated Sensors Laboratory Program, and the United States Air Force Electronics Parts Obsolescence Initiative. I have received an IBM Faculty Award and NSF’s

Research Initiation Award. I have been awarded the 2006 Frederick Emmons Terman Medal by the American Society of Engineering Education for contributions to Electrical Engineering, including authoring a widely used textbook in the design of VLSI (very large scale implementation) digital signal processors.

7. During the past 30 years at Georgia Tech, I have created and taught undergraduate and graduate courses in hardware and software design for signal processing, computer engineering (software and hardware systems), computer engineering and wireless communication circuits.

8. I have been involved in research and technology in the area of digital signal processing since the late 1980s, and I am the Editor-in-Chief of the CRC Press's 3-volume Digital Signal Processing Handbook (1998, 2010). I am the author of VLSI Digital Signal Processors (1995). I have been on the Editorial Board for the International Journal in VLSI Signal Processing since 1995. I am an author of numerous journal publications in this field, including, for example: (1) Efficient VLSI Architectures for the Arithmetic Fourier Transform (AFT) (1993); (2) The Georgia Tech digital signal multiprocessor (1993); (3) LMSGEN: a prototyping environment for programmable adaptive digital filters in VLSI (1994); (4) Fixed-point co-design in DSP (1994); (5) Rapid prototyping on the Georgia Tech digital signal multiprocessor (1994); (6) Low-power signaling in asymmetric noisy

channels via spectral shaping (1994); and (7) A quantitative methodology for rapid prototyping and high-level synthesis of signal processing algorithms (1994).

9. For decades I have been involved in research and technology in the area of hardware design. I am one of the authors of the Standard Language for Hardware Design (VHDL), which is an IEEE standard. I also authored or edited: (1) Quick-Turnaround ASIC Design in VHDL (1996); (2) VHDL: Electronics Systems Design Methodologies (2000); and (3) A Platform-Centric Approach to System-on-Chip (SoC) Design (2004). Additionally, I authored numerous journal publications in this field including, for example: (1) Modeling COTS components in VHDL (1996); (2) VHDL-Based Rapid Systems Prototyping (1996); and (3) VHDL models supporting a system-level design process: a RASSP approach (1997).

10. I have founded three companies in the areas of signal processing, embedded software, military chipsets involving imaging technology, and software for computing and communications systems. I have supervised Ph.D. dissertations of over twenty engineers in the areas of computer engineering, signal processing, communications, rapid prototyping, and system-level design methodology.

11. I have designed several specialized computer and communication systems over the past two decades at Georgia Tech for such tasks as wireless audio and video processing and protocol processing for portable platforms, such as cell phones and PDAs. I have designed systems that are efficient in view of performance,

size, weight, area, and thermal considerations. I have developed courses and classes for industry on these topics, and many of my lectures in advanced computer system design, developed under the sponsorship of the United States Department of Defense in the late 1990s, are available for educational use at <http://www.eda.org/rassp> and have been used by several U.S. and international universities as part of their course work. Some of my recent publications in the area of design of computer engineering and wireless communications systems and associated protocols are listed in Exhibit 2002.

12. In the mid-2006–2007 timeframe, I collaborated with Professor John Scharf and his colleagues at Emory Healthcare system in developing FFT-based pulse oximetry system prototypes on FPGAs (field-programmable gate arrays), which extended technologies developed by Prof. Scharf and his colleagues from the 1996 time frame (*See* T. Rush, R. Sankar, J. Scharf, “Signal Processing Methods for Pulse Oximetry,” *Comput. Bio. Med.*, Vol. 26, No. 2, 1996). Some of my more recent publications in the area of biological signal processing and bioinformatics are listed in my CV and include, A. Bahga, V. Madiseti, “Healthcare Data Integration and Informatics in the Cloud,” *IEEE Computer*, Vol. 48, Issue 2, 2015, and “Cloud-Based Information Integration Informatics Framework for Healthcare Applications,” *IEEE Computer*, Issue 99, 2013. In addition to my signal processing experience specific to pulse oximetry, I also have experience in developing systems

for other physiological signals. Beginning in the early 1990s, I worked, in particular, with ECG/EKG signals, and, in general, with biomedical signals and systems.

13. In addition to my signal processing experience specific to pulse oximetry, I also have experience in developing algorithms and systems for other physiological signals. I worked with ECG/EKG signals in particular, and biomedical signals and systems in general, beginning in the early 1990s. In particular, I worked with graduate student Dr. Shahram Famorzadeh, in 1990 and 1991, to analyze and apply pattern recognition (a category of signal processing algorithms that is based on correlation with a set of templates) to ECG/EKG waveforms to identify physiological conditions.

14. I have experience with biomedical signals and devices in the field of speech and image processing since the late 1980s. I developed deconvolution algorithms for use with physiological signals in the 1993-1998 timeframe. These signal processing techniques can be applied to pulse oximetry signals, and I have been working with these techniques since the mid-1980s.

15. I have studied, researched, and published in the area of adaptive filter signal processing for noise reduction and signal prediction, using correlation-based approaches since the mid-1980s, both in the time-domain and frequency domain, and also to ray-tracing applications, such as Seismic Migration for oil and shale gas exploration. See, e.g., V. Madisetti and D. Messerschmitt, Dynamically Reduced

Complexity Implementation of Echo Cancellers, IEEE International Conference on Speech, Acoustics and Signal Processing, ICASSP 1986, Tokyo, Japan; M. Romdhane and V. Madisetti, “All-Digital Oversampled Front-End Sensors” IEEE Signal Processing Letters, Vol. 3, Issue 2, 1996; “LMSGEN: A Prototyping Environment for Programmable Adaptive Digital Filters in VLSI,” VLSI Signal Processing, pp. 33–42, 1994.

16. Deconvolution of symmetric (seismic) and asymmetric (pulse oximetry) signals has gained much importance and some of my early work on “Homomorphic Deconvolution of Bandpass Signals” in IEEE Transactions on Signal Processing, October 1997, established several new methods for deconvolution of such signals that had several advantages of robustness, increased accuracy, and simplicity.

17. For over 20 years, I have worked in the area of user interfaces as part of my extensive development of applications for mobile devices. For example, in the late 1990s and early 2000s, I developed user interfaces for tools used by the United States Air Force, Lockheed Martin, and Boeing for automating the electronic design of complex chipsets and the reverse engineering of such components. As another example, from 1999–2003, I consulted with a team of engineers to design an integrated Soft Switch & Media Server, the SNX 850/8500, that was being sold and installed in Asia. The SNX 8500 was a one-box solution to VOIP, LAN

switching, and iPBX/PBX solutions for enterprise customers. I worked with that team of engineers to develop the user interfaces for the SNX 8500 product. More recently, I worked to develop a web-based document management environment called CatchUp, and developed the user interface for this product, which was subsequently commercialized as CatchUp Cloud.

18. I have studied, researched, and published in the area of user interface development, including on the development of user interfaces for applications on mobile platforms such as iPhone's iOS, Google's Android, or RIM's Blackberry. *See, e.g.*, N. Radia, Y. Zhang, M. Tatipamulaa, and V. Madisetti, "Next-Generation Applications on Cellular Networks: Trends, Challenges, and Solutions," Vol. 100, No. 4, April 2012, Proceedings of the IEEE.

19. I am a named inventor on 32 issued or allowed U.S. patents. Several of my patents disclose techniques for efficient user interface design, including the use of multi-level hierarchies and other innovations in user interface design. *See, e.g.*, U.S. Patent No. 11,741,052, U.S. Patent No. 11,314,695, U.S. Patent No. 11,226,938, U.S. Patent No. 11,080,240.

20. I have authored several peer-reviewed papers in the area of computer systems, instruments, and software design, and these include:

- Madisetti, et al., "The Georgia Tech Digital Signal Multiprocessor," IEEE Transactions on Signal Processing, Vol. 41, No. 7, July 1993.

- V. Madisetti et al., “Rapid Prototyping on the Georgia Tech Digital Signal Multiprocessor,” IEEE Transactions on Signal Processing, Vol. 42, March 1994.
- V. Madisetti, “Reengineering legacy embedded systems,” IEEE Design & Test of Computers, Vol. 16, Vol. 2, 1999.
- V. Madisetti et al., “Virtual Prototyping of Embedded Microcontroller-based DSP Systems,” IEEE Micro, Vol. 15, Issue 5, 1995.
- V. Madisetti, et al., “Incorporating Cost Modeling in Embedded-System Design,” IEEE Design & Test of Computers, Vol. 14, Issue 3, 1997.
- V. Madisetti, et al., “Conceptual Prototyping of Scalable Embedded DSP Systems,” IEEE Design & Test of Computers, Vol. 13, Issue 3, 1996.
- V. Madisetti, Electronic System, Platform & Package Codesign,” IEEE Design & Test of Computers, Vol. 23, Issue 3, June 2006.
- V. Madisetti, et al., “A Dynamic Resource Management and Scheduling Environment for Embedded Multimedia and Communications Platforms,” IEEE Embedded Systems Letters, Vol. 3, Issue 1, 2011.
- N. Radia, Y. Zhang, M. Tatipamulaa, and V. Madisetti, “Next-Generation Applications on Cellular Networks: Trends, Challenges, and Solutions,” Vol. 100, No. 4, April 2012, Proceedings of the IEEE.

21. Given my education and experience, I have been previously admitted as an expert witness in cases in the field of physiological monitoring technologies and user interfaces. For example, I have provided opinions regarding the validity of the '159 Patent and its related patent family members, U.S. Patent No. 10,687,745 ('745 Patent) and U.S. Patent No. 10,687,743 ('743 Patent) in the ITC Investigation and the Delaware Litigation. Therefore, I am familiar with the pulse oximetry technology described in the '159 Patent and the parties' dispute surrounding said technology.

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

22. I have been asked to provide technical expert opinions relating to the validity of the claims of the '159 Patent. In forming my opinions expressed in this Declaration, I have reviewed and considered the '159 Patent's claims, specification, drawings, and file history. I have also reviewed and considered Apple's petition, the prior art references that Apple relies on, the Declaration of Dr. Brian Anthony (EX1003), and all other exhibits Apple submitted in this proceeding. I have also reviewed the Board's Institution Decision.

23. As mentioned above, I have provided my opinions regarding the validity of the '159 Patent, the '745 Patent, and the '743 Patent in other related cases. I thus have also considered the documents and information referenced expressly or implicitly in my expert reports or declarations in those related cases.

24. I have further reviewed and considered at least the following materials in preparing this Declaration:

| <b>Exhibit No.</b> | <b>Description</b>                                                                                                                                                   |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2003               | Commission Opinion (Public), Certain Light-Based Physiological Measurement Devices and Components Thereof, Inv. No. 337-TA-1276, EDIS No. 808521 (ITC Oct. 26, 2023) |
| 2029               | June 6–10, 2022 Public Hearing Transcript, ITC Inv. No. 337-TA-1276                                                                                                  |
| 2032               | November 17, 2023 Letter from U.S. Food & Drug Administration to Masimo Corp. re Masimo W1 510(k) Clearance                                                          |
| 2035               | Final Written Decision (Public Version), Apple Inc. v. Masimo Corp., IPR2022-01291 (Jan. 30, 2024)                                                                   |
| 2036               | Final Written Decision (Public Version), Apple Inc. v. Masimo Corp., IPR2022-01465 (Feb. 2, 2024)                                                                    |
| 2037               | Redacted Excerpt of the December 15, 2023 Rebuttal Report of Dr. Majid Sarrafzadeh (Apple’s expert in the Delaware Litigation)                                       |
| 2038               | Joint Claim Construction Statement Regarding Masimo Asserted Patents, Apple Inc. v. Masimo Corp., No. 22-1378-MN-JLH (Aug. 31, 2023)                                 |
| 2039               | Petitioner’s Reply (Public Version), Apple Inc. v. Masimo Corp., IPR2022-01291                                                                                       |
| 2042               | Masimo’s Post-Hearing Brief (Public Version), ITC Inv. No. 337-TA-1276                                                                                               |
| 2043               | ITC Final Initial Determination (Public Version), ITC Inv. No. 337-TA-1276                                                                                           |

| Exhibit No. | Description                                                                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2050        | Apple Inc.'s Post-Hearing Brief (Public Version), ITC Inv. No. 337-TA-1276                                                                                                                                        |
| 2056        | Excerpts of File History of App. No. 16/532,065                                                                                                                                                                   |
| 2057        | Excerpts of File History of App. No. 15/195,199                                                                                                                                                                   |
| 2072        | Excerpt of Webster's II New College Dictionary (2001)                                                                                                                                                             |
| 2074        | Nonconfidential Excerpt of Page 65 from June 6-10, 2022 Hearing Transcript, ITC Inv. No. 337-TA-1276                                                                                                              |
| 2069        | Eric W. Weisstein, <i>Annulus</i> , Wolfram MathWorld (Dec. 1, 2022, 3:20 pm), <a href="https://mathworld.wolfram.com/Annulus.html">https://mathworld.wolfram.com/Annulus.html</a>                                |
| 2072        | Excerpt of Webster's II New College Dictionary (2001)                                                                                                                                                             |
| 2074        | Nonconfidential Excerpt of Page 65 from June 6-10, 2022 Hearing Transcript, ITC Inv. No. 337-TA-1276                                                                                                              |
| 2076        | CONFIDENTIAL – Transcript of Testimony of Brian Land from June 6-10, 2022 Hearing Transcript, <i>Certain Light-Based Physiological Measurement Devices and Components Thereof</i> , Inv. No. 337-TA-1276          |
| 2077        | CONFIDENTIAL – Transcript of Testimony of Dr. Paul Mannheimer from June 6-10, 2022 Hearing Transcript, <i>Certain Light-Based Physiological Measurement Devices and Components Thereof</i> , Inv. No. 337-TA-1276 |
| 2078        | CONFIDENTIAL – Transcript of Testimony of Dr. Stephen Waydo from June 6-10, 2022 Hearing Transcript, <i>Certain Light-Based Physiological Measurement Devices and Components Thereof</i> , Inv. No. 337-TA-1276   |
| 2080        | CONFIDENTIAL – ITC Exhibit CX-0289C – Designated Portions of February 10, 2022 Deposition of Dr. Paul Mannheimer                                                                                                  |

| <b>Exhibit No.</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2081               | CONFIDENTIAL – ITC Exhibit CX-0299C – Designated Portions of February 18, 2022 Deposition of Dr. Stephen Waydo                                                                                                                                                                                                                                                                                                     |
| 2082               | CONFIDENTIAL – ITC Exhibit CX-0295C – Designated Portions of February 11, 2022 Deposition of Tao Shui                                                                                                                                                                                                                                                                                                              |
| 2083               | CONFIDENTIAL – ITC Exhibit CX-0007C – Email from Brian Land to Paul Mannheimer et al.                                                                                                                                                                                                                                                                                                                              |
| 2084               | CONFIDENTIAL – ITC Exhibit CX-0175C – Apple Organization Chart                                                                                                                                                                                                                                                                                                                                                     |
| 2085               | CONFIDENTIAL – ITC Exhibit CX-0177C – Apple Presentation                                                                                                                                                                                                                                                                                                                                                           |
| 2086               | CONFIDENTIAL – ITC Exhibit CX-0185C – Apple Presentation                                                                                                                                                                                                                                                                                                                                                           |
| 2088               | ITC Exhibit CX-1616 – Fowler, Geoffrey, “The new Apple Watch says my lungs may be sick. Or perfect. It can’t decide.” Washington Post, September 23, 2020 ( <a href="https://www.washingtonpost.com/technology/2020/09/23/apple-watch-oximeter/">https://www.washingtonpost.com/technology/2020/09/23/apple-watch-oximeter/</a> )                                                                                  |
| 2089               | CONFIDENTIAL – ITC Exhibit CX-1793C – Apple Presentation                                                                                                                                                                                                                                                                                                                                                           |
| 2091               | William, Andrews, “Fitbit Update Lets You Quickly Check Your Blood Oxygen Saturation.” Forbes, Sept. 9, 2020 ( <a href="https://www.forbes.com/sites/andrewwilliams/2020/09/09/fitbit-update-lets-you-quickly-check-your-blood-oxygen-saturation/?sh=5d6ecb55e76a">https://www.forbes.com/sites/andrewwilliams/2020/09/09/fitbit-update-lets-you-quickly-check-your-blood-oxygen-saturation/?sh=5d6ecb55e76a</a> ) |
| 2092               | “Track Your SpO2 to Uncover Changes in Your Wellbeing,” Fitbit, Sept. 7, 2020 ( <a href="https://blog.fitbit.com/track-your-spo2/">https://blog.fitbit.com/track-your-spo2/</a> )                                                                                                                                                                                                                                  |
| 2093               | CONFIDENTIAL – ITC Final Initial Determination (Public version filed at Exhibit 2043)                                                                                                                                                                                                                                                                                                                              |

| <b>Exhibit No.</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                    |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2094               | CONFIDENTIAL – Transcript of November 7, 2023 Deposition of Dr. Paul Mannheimer, <i>Apple Inc. v. Masimo Corp. et al.</i> , Nos. 22-1377-MN-JLH, 22-1378-MN-JLH (D. Del.)                                                                                                                                             |
| 2095               | Stein, “Withings Pulse O2 review: Fitness band plus heart rate monitor checks blood oxygen, too,” CNET.com (April 25, 2014), <a href="https://www.cnet.com/reviews/withings-pulse-o2-review/">https://www.cnet.com/reviews/withings-pulse-o2-review/</a> (Previously filed by Apple as Exhibit 1057 in IPR2022-01291) |
| 2096               | CONFIDENTIAL - Final Written Decision, <i>Apple Inc. v. Masimo Corp.</i> , IPR2022-01291 (Jan. 30, 2024) (Public version previously filed as EX2035)                                                                                                                                                                  |
| 2097               | Excerpt of C. A. Bennett, <i>Principles of Physical Optics</i> , John Wiley & Sons, Inc. (2008)                                                                                                                                                                                                                       |
| 2098               | CONFIDENTIAL - Excerpt of December 15, 2023 Expert Report of Majid Sarrafzadeh, Ph.D. Regarding Non-Infringement of U.S. Patent Nos. 10,687,743 & 10,722,159, <i>Apple Inc. v. Masimo Corp.</i> , C.A. Nos. 22-1377-MN-JLH, 22-1378-MN-JLH                                                                            |
| 2099               | Transcript of Hearing Held November 17, 2023 in IPR2022-01291, -01465 (Public Version)                                                                                                                                                                                                                                |
| 2101               | Document produced by Apple in related litigation bearing production numbers APL-MAS_00117783-877                                                                                                                                                                                                                      |
| 2102               | Excerpt of document produced by Apple in related litigation bearing production numbers APL_DEL03985999-6078                                                                                                                                                                                                           |
| 2103               | Document produced by Apple in related litigation bearing production numbers APL_MAS_ITC_00311268-73                                                                                                                                                                                                                   |
| 2104               | Document produced by Apple in related litigation bearing production numbers APL-MAS_01812072-78                                                                                                                                                                                                                       |
| 2105               | Petition, <i>Apple Inc. v. Masimo Corp.</i> , IPR2020-01722                                                                                                                                                                                                                                                           |

| Exhibit No. | Description                                                                                                                                                  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2106        | “How to use the Blood Oxygen app on Apple Watch,” Apple Inc. ( <a href="https://support.apple.com/en-us/120358">https://support.apple.com/en-us/120358</a> ) |
| 2107        | Transcript of October 28, 2024 Deposition of Dr. Brian Anthony                                                                                               |

To the extent not listed above, I have also reviewed any other materials referenced expressly or implicitly herein.

25. In forming my opinions in this Declaration, I have also relied upon my educational and professional experience. I understand that my analyses and opinions should be made from the perspective of one of ordinary skill in the art (i.e., a “POSITA”) related to the ’159 Patent at the relevant time, which is July 2, 2015.

26. Any figures appearing in this Declaration were prepared with the assistance of counsel and reflect my understanding of the ’159 Patent and the materials discussed in this Declaration. Additionally all emphases in quotes are added unless stated otherwise.

### **III. APPLICABLE LEGAL STANDARDS**

27. I am not an attorney and I will not offer opinions of law. However, I have been informed of several principles of law concerning patent claim construction and validity, which I apply in addressing the challenged claims.

#### **A. Claim Construction**

28. 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. I further understand that claim terms should be construed the same way for purposes of validity and infringement. 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.

**B. Obviousness**

29. I understand from counsel that, under 35 U.S.C. § 103, a patent claim is obvious if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date (which is July 2, 2015 here) to a person having ordinary skill in the art to which the claimed invention pertains.

30. I understand from counsel that the factors to be considered in an obviousness inquiry include: (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 pertinent art, and (4) objective considerations of nonobviousness (also referred to as secondary considerations) such as commercial success, industry praise, teaching away, long-felt need, failure of others, skepticism, unexpected results, and copying. I understand that all of these factors must be considered in an obviousness analysis. I also understand that to establish any such evidence as objective considerations of nonobviousness, a nexus must be shown between the evidence and the claimed invention.

31. I understand from counsel that the obviousness inquiry must be made without hindsight. I also understand from counsel that the POSITA cannot use the knowledge only taught by the patented invention against the patentee. I understand from counsel that care must be taken to avoid hindsight reconstruction by using the patent as a guide to combine prior art references to achieve the result of the challenged claims.

32. I understand from counsel that a reference is available as prior art if it is analogous art. I understand that a reference is analogous art if it falls with the same field of endeavor as the claimed invention or, if not, if it is reasonably pertinent to the particular problem to which the inventor is involved.

33. I understand from counsel that that the motivation to combine or modify the prior art must be clear and particular and be supported by more than conclusory statements. I also understand from counsel that the following principles signal that a motivation to make a proposed combination is lacking:

- a. If the proposed modification would render the prior art being modified unsatisfactory or inoperable for its intended purpose;
- b. If the proposed modification or combination of the prior art would change the principle of operation of the prior art being modified; and/or
- c. If the prior art teaches away from modifying or combining certain known elements.

34. I understand from counsel that even if a skilled artisan would be motivated to combine two or more prior art references, there must be a reasonable expectation that the combination would be successful. I also understand from counsel that a “reasonable expectation of success” does not require that a skilled artisan would have been absolutely certain that the invention would work for its intended purpose.

35. I understand from counsel that when combining disclosures from multiple references, combining multiple embodiments from a single reference, or selecting from large lists of elements in a single reference, there must be a motivation to make the combination and a reasonable expectation that such a combination would be successful.

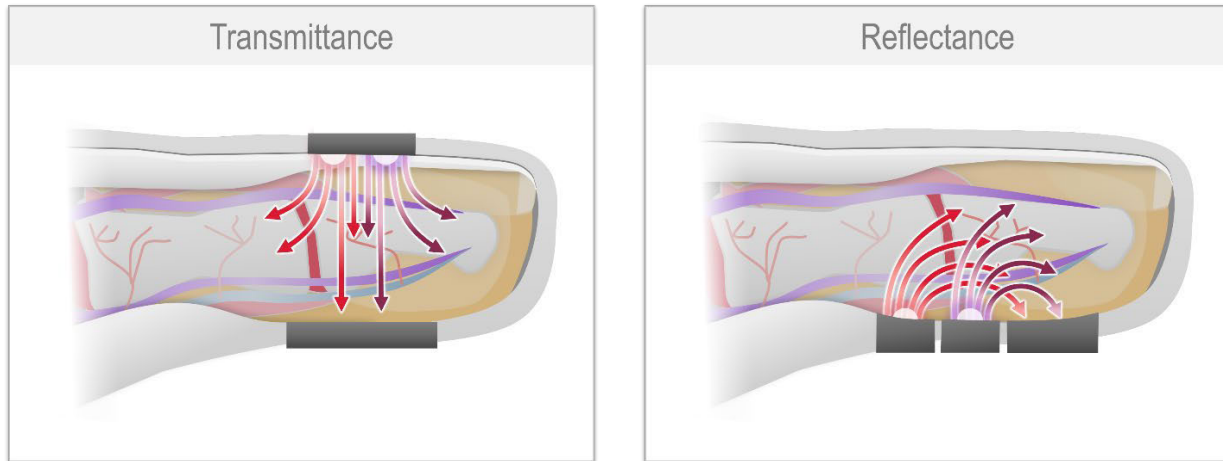
#### **IV. BACKGROUND OF THE TECHNOLOGY**

##### **A. Light-Based Noninvasive Physiological Monitoring**

36. Pulse oximetry is a noninvasive method of measuring the arterial oxygen saturation of a patient's blood. Pulse oximetry relies on the Beer-Lambert law, which allows the concentrations of oxygenated hemoglobin (oxyhemoglobin) and deoxygenated hemoglobin to be calculated by measuring the absorption of light through the user's blood at known wavelengths. *See* '159 Patent, 1:30–2:3; *see also* EX1009, 40, 44. Pulse oximeters typically use LEDs to emit light of at least two wavelengths, most commonly red and infrared. *See* EX1009, 34–36, 44; EX1001, 1:61–65. Red and infrared are typically chosen for use in pulse oximeters because hemoglobin absorbs more red light than oxyhemoglobin, while oxyhemoglobin absorbs more infrared light than hemoglobin. *See id.* at 35, 44.

37. The emitted red and infrared light enters into the user's tissue where some of the light is absorbed by the blood and other tissue. *See* EX1009, 36–39. One or more photodetectors can then detect the amount of light that transmits through to the other side of the tissue or that reflects back out of the same side of the tissue that the light entered from. *See id.* A pulse oximeter where the photodetector and light emitters are placed on opposite sides of the tissue is known as a transmittance pulse oximeter, while a pulse oximeter that has the photodetector and light emitters on the

same side of the tissue is known as a reflectance pulse oximeter. *Id.* The following images illustrate a transmittance and reflectance pulse oximeter:



38. The photodetector(s) generate a photoplethysmography (PPG) signal for each wavelength of light. *See* EX1009, 35–36. The amount of blood in the patient’s arteries changes as the heart contracts (systole) and relaxes (diastole). *Id.* at 46–47. A PPG signal can be separated into a pulsatile (“AC”) component caused by arterial blood and a nonpulsatile (“DC”) component. *See id.* Complex algorithms can then be used to calculate a ratio of the AC/DC components for each of the red and infrared signals, resulting in a ratio of ratios. *Id.* at 48–51, 54. This ratio of ratios can then be mapped empirically to an oxygen saturation ( $\text{SpO}_2$ ) value, which indicates the proportional amount of hemoglobin carrying oxygen. *Id.* at 54.

**B. The '159 Patent (EX1001)**

39. The '159 Patent is entitled “Physiological Monitoring Devices, Systems, and Methods.” The '159 Patent claims priority to a provisional application

filed July 2, 2015. The claimed devices and systems are the result of work conducted by inventor Ammar Al-Ali's research into measuring various physiological parameters, such as pulse oximetry, at the wrist in the 2014–2015 time frame. The sensor designs claimed in the '159 Patent include various features that improve the signals, which are typically obscured by noise, used to non-invasively measure physiological parameters, such as oxygen saturation, at difficult locations, such as the wrist. *See, e.g.*, '159 patent at 7:4–62, 8:54–9:10, 10:40–11:67, Figs. 7A-7B, Claims 1, 8, 19, 22.

40. For example, independent Claims 1 and 19 of the '159 Patent claim sensors that measure from difficult locations such as the wrist using a device comprising a “material” “configured to change the first shape [of light emitted from a plurality of emitters] into a second shape.”<sup>1</sup> The claims also recite a “light block configured to prevent at least a portion of the light” from the emitter from reaching

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<sup>1</sup> I understand Apple and Masimo agreed in the Delaware Litigation that “second shape” means “shape different from the first shape (not just a change in size).” EX2038, 5. I understand, for example, that intensity can, but not necessarily, affect the shape of light if it can create new geometries, like for example, a circle inside another circle, as in the difference between a circular disk and a donut. *See, e.g.*, EX1001, 10:65–11:2, Fig. 7B.

the detectors without first reaching the tissue and a surface comprising a dark-colored coating. The '159 Patent explains that the conventional two-dimensional approach to pulse oximetry using a point optical source results in a problem known as “multiple scattering.” EX1001, 5:41–6:20. “Multiple scattering” refers to the phenomenon where the red and IR photon pathlengths vary through the tissue. *Id.* A study found that this variation in average pathlengths between the red and IR photons affects the calibration curve for a pulse oximeter, and therefore the accuracy of the measurements. *Id.* at 5:41–6:20. Al-Ali discovered that implementing the claimed devices, including the material that changes the shape of light, allowed for a three-dimensional approach which irradiates a large volume of tissue at the measurement site and improves accuracy. *Id.* at 6:21–7:3. Advantageously, the increased light interaction leads to more accurate oxygen saturation measurements. *Id.* at 6:64–7:3.

41. The additional features of a dark-colored coating and a light-block found in the claims are also important to measurement accuracy. The '159 Patent explains that the use of the dark-colored coating also addressed the “multiple scattering” problem caused by light reflecting back and forth between the user’s tissue and the sensor. EX1001, 8:54–9:7. The “light block” prevents unwanted LED light from reaching the photodiode detectors without first passing through the tissue. *Id.* at 10:49–51, 11:10–20, Figs. 7A-7B. This novel combination of features thus

provides improved accuracy and ability to measure difficult physiological parameters, such as oxygen saturation at the wrist.

42. The novel combinations of features in the claimed inventions of the '159 Patent together allow improvement of the measurement of a user's physical parameters, such as oxygen saturation, at difficult locations like the user's wrist. *See, e.g.,* EX1001, 10:40-51, Figs. 7A-7B.

43. Based on Al-Ali's research and the resulting '159 Patent inventions, Masimo developed the Masimo W1™ which is a commercial medical-grade watch with a pulse oximeter that measures SpO<sub>2</sub> continuously at the wrist. EX2029, 248:24-250:14.



44. I understand the Masimo W1™ has received FDA 510(k) clearance for over-the-counter (OTC) and prescription use (Rx) for oxygen saturation monitoring. EX2032. I also understand that as of today, Masimo remains the first and only company in the world to have received FDA clearance for a pulse oximeter that measures continuously from the wrist.

**C. Apple's Asserted References**

**1. Iwamiya (EX1004)**

45. U.S. Patent No. 8,670,819 to Iwamiya et al. is titled “OPTICAL BIOLOGICAL INFORMATION DETECTING APPARATUS AND OPTICAL BIOLOGICAL INFORMATION DETECTING METHOD.” Iwamiya discloses an optical sensor built into a wristwatch that can measure “biological information.” EX1004, 5:54–67. The only example of “biological information” disclosed in Iwamiya is a “pulse wave” which measures pulse rate. *Id.* at 9:4–5. Iwamiya does not mention measurement of oxygen saturation. Iwamiya also identifies a problem where melanin pigment in the skin absorb visible light such that the received signal is too weak to detect a pulse wave. *Id.* at 1:53–2:6. To address that problem, Iwamiya uses a single wavelength of light at 940 nm. *Id.* at 10:34–43. Iwamiya also teaches the use of an optical filter placed over the light detector to filter out light with a wavelength under 900 nm to “alleviate[] an influence from a measurement change due to external light, such as sunlight.” *Id.* at 8:38–47.

**2. Sarantos (EX1005)**

46. U.S. Patent No. 9,392,946 to Sarantos et al. is titled “HEART RATE SENSOR WITH HIGH-ASPECT-RATIO PHOTODETECTOR ELEMENT” and was originally assigned to Fitbit, Inc. EX1005 at Title. Sarantos’s heart rate sensors have “high-aspect-ratio” (HAR) photodetector elements that differ from conventional square photodetector elements. *Id.* at 9:48–10:15. Compared to the conventional square photodetectors, Sarantos proposes using HAR photodetectors to improve light collection capabilities while maintaining substantially the same active area. *See id.* at 10:27–50, FIG. 5. Sarantos explicitly limits its discussion on HAR photodetectors to be “primarily with respect to light sources that emit green light, e.g., wavelengths in the range of 500 nm to 550 nm,” which are “particularly well-suited for photoplethysmographic techniques for measuring heart rate.” *Id.* at 18:35–44. Sarantos cautions that “although it is contemplated that the photodetector element concepts discussed herein may see similar performance with light sources that emit light predominantly in the 500 nm to 600 nm range, which includes yellow light as well as some light orange light,” the invention is “not tailored for use in other spectrums, such as the red or infrared spectra.” *Id.* at 18:35–51.

**3. Han and Utter (EX1008, EX1006)**

47. Apple also relies upon two additional references, Han (EX1008) and Utter (EX1006) for various limitations. However, as explained below, all of Apple’s

grounds fail to demonstrate obviousness because Apple fails to demonstrate that Sarantos in combination with Shie would render the independent claims obvious. I reserve all rights to supplement my opinions regarding these references and Apple's arguments based on these references if IPR is instituted.

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

48. I understand the Board's Institution Decision adopted Apple's definition of the level of ordinary skill in the art. Inst., 13-14. The Board's adopted definition is set forth below:

A person of ordinary skill in the art relating to the subject matter of the '159 Patent ("POSITA") would have had a working knowledge of physiological monitoring technologies. The person would have had a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information, including but not limited to physiological monitoring technologies. APPLE-1003, [¶¶20-22]. 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.

Inst., 13 (quoting Pet., 4).

49. I have reviewed the Board's adopted definition of the level of ordinary skill in the art. I met and exceeded the level of ordinary skill in the art. Although I do not necessarily agree with this definition, any differences between my opinion on

the level of ordinary skill in the art and the Board's adopted definition are not material to the issues in this proceeding.

## VI. CLAIM CONSTRUCTION

A. **“the plurality of detectors are arranged in an array having a spatial configuration corresponding to a shape of the portion of the tissue measurement site bounded by the circular shaped light block”**  
**(Claim 14)**

50. Claim 14 requires a plurality of detectors that are “arranged in an array having a spatial configuration corresponding to a shape of the portion of the tissue measurement site bounded by the circular shaped light block.” A POSITA would have understood from the prosecution history of a parent application (App. No. 15/195,199) (“’199 Application”) that arrangements of two or three detectors are excluded from the scope of Claim 14. EX2057, 322. Specifically, during prosecution of that application, Masimo explained:

**‘arranged in an array having a spatial configuration corresponding to the shape of the irradiated portion of the tissue measurement site’** ... would be understood by a person having ordinary skill in the art as requiring a sufficient number of detectors such that, when arranged together in an array, can “match,” “have a close similarity,” or “represent” the “at least partially circular shape” of the irradiated portion of the tissue measurement site. ...

In order for the claimed “plurality of detectors” to “match” or “represent” an “at least partially circular shape” or an “annular shape,” the “plurality of detectors” must include sufficient detectors to

represent such shapes. For example, six or more detectors could be arranged in an annular shape and meet the recited limitation. **However, two detectors, for example, can only be arranged in a spatial configuration representing a line and three detectors, for example, can only be arranged in a spatial configuration representing a line or a triangle.**

EX2057 at 322. Due to the similarity in language between the claim limitation at issue in the '199 Application and Claim 14 of the '159 Patent, a POSITA would understand that Claim 14 excludes arrangements of two or three photodetectors, because those arrangements cannot represent “a shape of the portion of the tissue measurement site bounded by the circular shaped light block.”

51. I understand the Board previously adopted Masimo’s construction of a nearly identical limitation in Claim 15 of the related '745 Patent. *See* IPR2022-01291, Final Written Decision, 109–112 (construing “a plurality of photodiodes...arranged in an array having a spatial configuration corresponding to a shape of the portion of the tissue measurement site encircled by the light block” to require more than three photodiodes). I also understand the Board adopted Masimo’s construction in the Institution Decision. Inst., 17-19. I believe the Board should continue to apply this understanding to Claim 14 of the '159 Patent.<sup>2</sup>

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<sup>2</sup> I also provide opinions regarding the construction of “through the surface” in

## **VII. SUMMARY OF OPINIONS**

52. It is my conclusion, from a technical point of view, that Claims 1–25 of the '159 Patent would not have been obvious to a POSITA based on the grounds asserted by Apple in the '243 Petition. In particular, it is my opinion that:

- (Ground 1A) Claims 1–2, 4–13 would not have been obvious to a POSITA based on Iwamiya and Sarantos;
- (Ground 1B) Claim 3 would not have been obvious to a POSITA based on Iwamiya, Sarantos, and Han; and
- (Ground 1C) Claims 14–25 would not have been obvious to a POSITA based on Iwamiya, Sarantos, and Utter.

## **VIII. ANALYSIS**

### **A. The Iwamiya-Sarantos Combination Fails to Disclose [1.4], [1.5], and [19.5] Under Apple's Proposed Construction in the Delaware Litigation**

53. Claims 1 and 19 both recite “a surface comprising a dark-colored coating, the surface positioned between the plurality of detectors and the tissue when the physiological monitoring device is in use, wherein an opening defined in the dark-colored coating is configured to allow at least a portion of light reflected from the tissue to pass through the surface.” Apple labels this limitation as Limitations [1.4]

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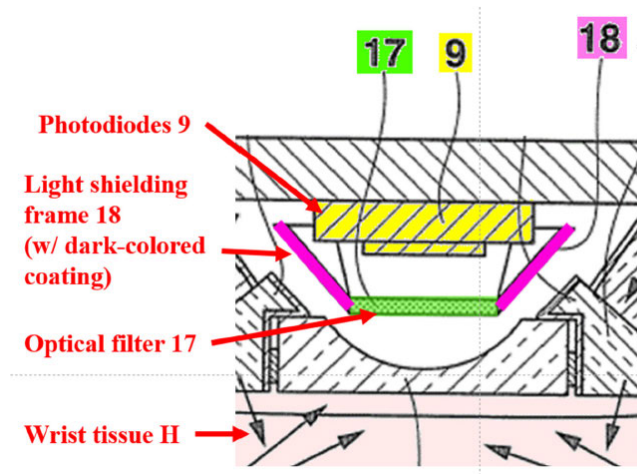
Section VIII.C. and “determine...oxygen saturation” in Section VIII.D.4.

and [1.5] for Claim 1 and Limitation [19.5] for Claim 19. I understand that Apple did not set forth any express construction of “opening” in the Petition, leaving all terms to their plain and ordinary meaning. Pet., 4-5.

54. In the Delaware Litigation, Apple and its expert, Dr. Sarrafzadeh, argued that the plain and ordinary meaning of “opening” means “empty space.” EX2037, ¶465. Dr. Sarrafzadeh explained that an opening that is filled with solid material, “such as closed windows and solid lenses” cannot satisfy the claim limitation. EX2037, ¶479. According to Dr. Sarrafzadeh, “[A]n opening is an empty space. Especially in the field of optics, light traveling through space in an opening is not equivalent to light traveling through a material, such as a window.” EX2037, ¶482. Under that construction, the Iwamiya-Sarantos combination cannot satisfy the claim limitation because the “optical filter 17” that Apple identified as the “opening” is a solid material, not empty space.

55. As illustrated in the figure below, Apple identified Iwamiya’s “light shielding frame 18” as the recited “surface.” Pet., 21 (“the Iwamiya-Sarantos combination includes a ‘light shielding frame 18’ (the claimed ‘surface’) surrounding the photo diodes/light receiving units 9 ... with a dark-colored coating, as taught by Sarantos”); *see also id.* at 65 (Apple’s argument for [19.5] cross-references its [1.4], [1.5] arguments). Under Apple’s obviousness theory, a POSITA would have coated the light shielding frame 18 with a dark-colored coating from Sarantos. *See id.* at 9,

21. Apple then identified the optical filter 17, which is a physical structure “mounted on the lower side of a light shielding frame 18” as the claimed “opening.” *See* Pet., 23–24 (quoting EX1004, 8:39–42). According to Apple, the optical filter “is configured to allow at least a portion of light reflected from the tissue to pass through this surface to the photodiodes 9.” Pet., 24.



Pet., 24 (Apple’s annotations of EX1004, Fig. 4).

56. However, as Iwamiya confirms, the optical filter 17 is a solid material that is mounted on the light shielding frame. EX1004, 8:39–42. As Apple’s expert Sarrafzadeh stated, “A POSITA would not regard solid material as an ‘opening.’” EX2037, ¶465. Moreover, he emphasized that “[m]aterial, such as closed windows and solid lenses, are the opposite of an ‘opening’” and that “[s]tretching the claim term ‘opening’ to encompass a closed window as an equivalent would vitiate the requirement of an ‘opening.’” *Id.* at ¶479. Thus, under the plain and ordinary

meaning claim construction Apple is proposing in Delaware, the Iwamiya-Sarantos combination cannot demonstrate the obviousness of Claims 1 and 19.<sup>3</sup>

**B. A POSITA Would Not Have Been Motivated to Add a Dark-Colored Coating to Iwamiya’s Light Shielding Frame (Claims 1 and 19)**

57. As discussed above, Claims 1 and 19 both recite “a surface comprising a dark-colored coating, the surface positioned between the plurality of detectors and the tissue when the physiological monitoring device is in use.” Apple presents the same motivations to combine Iwamiya with Sarantos that it previously presented in IPR2022-01291, IPR2022-01465, and also in the ITC investigation. Apple acknowledges that Iwamiya does not disclose a “surface comprising a dark-colored coating.” Pet., 11 (“Iwamiya is silent as to the material or coating used to implement the light shielding frame 18....”). Apple argues that a POSITA would have added a

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<sup>3</sup> I note that Dr. Anthony’s declaration suggested that “removing the optical filter altogether, would still satisfy element [1.5].” EX1003, ¶65. However, the Petition did not make that argument. Pet., 23-24. Iwamiya does not disclose any embodiments where the optical filter is removed and Dr. Anthony did not provide any motivation for doing so. And that modification makes no sense because one of the purposes of the light shielding frame is to mount the optical filter—without an optical filter, there is no reason to have a light shielding frame.

dark-colored coating from Sarantos onto the light shielding frame 18 in Iwamiya. *See* Pet., 7-13, 21-23 (describing how Iwamiya’s light shielding frame would be coated with an in-mold label or mask from Sarantos).<sup>4</sup> Apple argues that a POSITA would have added a dark-colored coating to the light shielding frame to block light. Petition, 9 (arguing the combination would “improve[] characteristics for shielding the photodiodes from stray light,” “limit[] reflections” and “block light”). I have reviewed the Board’s public final written decisions in IPR2022-01291 and IPR2022-01465 and I understand the Board’s Institution Decision agreed with the prior final written decisions. Inst., 25-30. Although the Board found a motivation to combine Iwamiya and Sarantos in IPR2022-01291 and IPR2022-01465, I respectfully disagree with the Board’s previous decisions. In my opinion, a POSITA would not have been motivated to add a dark-colored coating to Iwamiya’s light shielding frame.

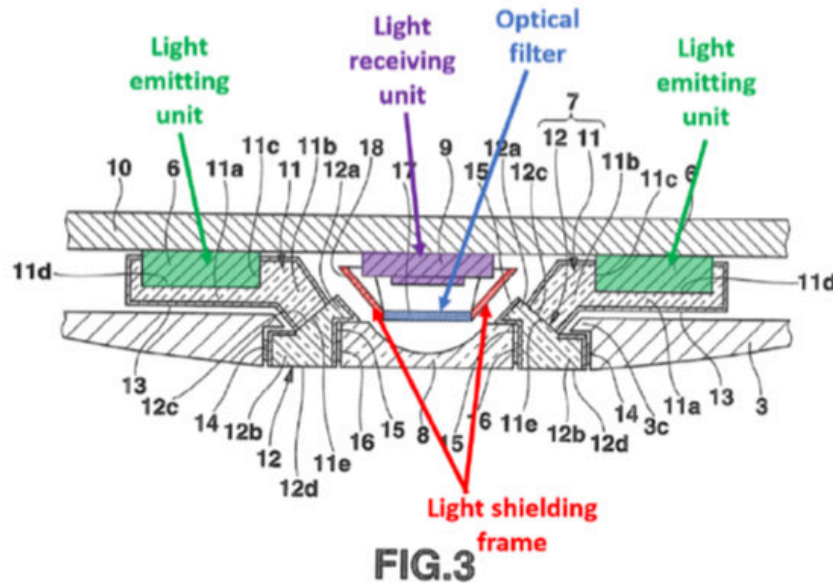
58. In IPR2022-01291, the Board found that Iwamiya “provides no detail concerning the *structural* configuration of frame 18” and “simply identifies the frame as ‘a light shielding frame,’ which is a functional description apart from the word

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<sup>4</sup> Sarantos’s “in-mold label” is not a coating. It is a label that exists inside of Sarantos’s window due to being placed within a mold during the manufacturing process of the window. EX1005, 17:4-10, Fig. 22. An in-mold label does not satisfy the “dark-colored coating” limitation.

‘frame.’” EX2096, 38 (emphasis in original). The Board then stated that “Iwamiya leaves it to a person of ordinary skill in the art to choose a material or structure to incorporate within frame 18 to shield light away from reaching light receiving unit 9 without passing through optical filter 17.” *Id.* The Board then concluded that “Apple’s reliance on Sarantos as disclosing a suitable light-shielding material or structure for use with Iwamiya’s frame 18 is invited by Iwamiya’s disclosure, rather than assuming a problem in Iwamiya that does not exist.” *Id.* The Board’s Institution Decision in this IPR agreed with the previous analysis in IPR2022-01291, stating that “although Iwamiya describes its light shielding frame as opaque, it does not speak to how its opacity is achieved, i.e., what materials and/or coatings are employed in order to render its frame opaque.” Inst., 28. Thus, the Board viewed the “use of Sarantos’s specific materials ... as implementing the opacity of Iwamiya’s light shielding frame rather than adding to it.” *Id.*

59. But the reasoning in IPR2022-01291 and the Institution Decision ignored Iwamiya’s extensive disclosure concerning the light shielding frame 18’s structural configuration. For example, Iwamiya’s Figures 1 through 4 show the structure of the light shielding frame 18 (highlighted red below):



EX1004, Fig. 3 (annotated). Iwamiya’s description also explains that the frame 18 is “light shielding,” that is “surround[s] the light receiving unit 9” and also has an optical filter mounted to it. EX1004, 8:38-42, Figs. 1-4. Thus, a POSITA would have clearly understood the structure of the frame 18 and its “light shielding” function. A POSITA would have readily understood that the light shielding frame is itself already made of a light shielding material and is therefore opaque.

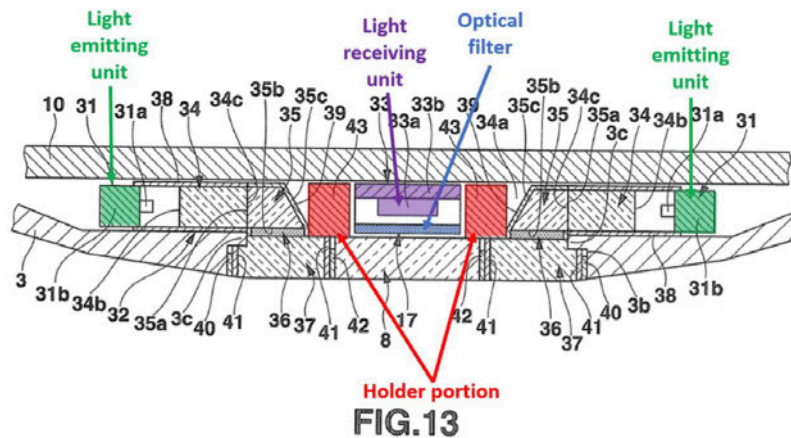
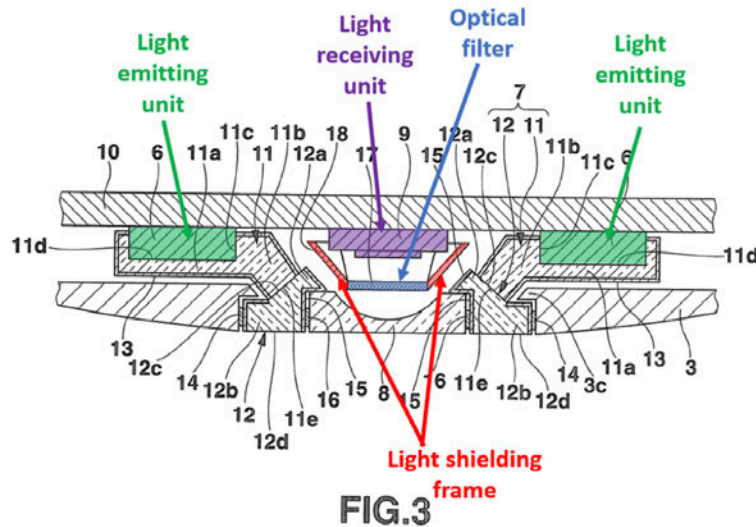
60. Additionally, Iwamiya already discloses a material that provides a “light shielding” function. Iwamiya describes, in relation to a similar structure called a “holder portion 43” in other embodiments, that “holder portion 43 of the light receiving unit 33 is formed of a metal with a light shielding property, such as aluminum, and its surface is subject to alumite treatment to have a reflection function.” EX1004, 18:61-65, *see also id.* at 28:64-29:5, 39:20-24. Moreover, a

POSITA would have found it meaningful that Iwamiya used the same “light shielding” terminology for both the “light shielding frame 18” and the “light shielding function” of the material. Thus, a POSITA would have understood that Iwamiya already disclosed that metal, such as aluminum, accomplishes the light shielding function. Thus, Iwamiya does speak to how its light shielding function is achieved—using a metal, such as aluminum.

61. I note that in the IPR2022-01291 final written decision, the Board dismissed Iwamiya’s disclosure of metal because it pertained to holder portion 43 from another embodiment. EX2096, 40. The Board stated, “However, holder portion 43 is a different structure than light shielding frame 18, as Iwamiya demonstrates by using different reference numerals 18 and 43 in the respective figures, whereas ‘the same components ... are denoted by the same reference numerals’ including scattered light taking unit 8 and optical filter 17.” *Id.* But this does not explain why a POSITA would have ignored Iwamiya’s express disclosure of a material that provides a “light shielding” function. That reasoning also makes little sense because if a POSITA somehow thought that Iwamiya’s disclosures about the holder portion 43 in another embodiment were irrelevant, then there would have been no reason at all a POSITA would have turned to a completely different structure from a completely different patent to fill the supposed gap in Iwamiya’s description of the light shielding frame. Additionally, a POSITA would have understood that the holder portion 43 in

Iwamiya's other embodiments is an analogous structure to the light shielding frame 18 in Iwamiya's first embodiment. The use of a different reference numeral "43" versus "18" does not end the analysis. Indeed, Iwamiya repeatedly used different reference numerals for structures that are the same or similar between its various embodiments. For example, Iwamiya refers to "light emitting units 6" (EX1004, 6:8) and "light emitting units 31" (*Id.*, 15:2), "annular light guide unit 7" (*Id.*, 6:11-12) and "annular light guide unit 32" (15:4-5), "light receiving unit 9" (*Id.*, 8:20) and "light receiving unit 33" (18:27-30). Iwamiya even explains that "light receiving unit 33" is similar to the light receiving unit 9 from the first embodiment. *Id.*, 18:27-30, 18:41-44. A POSITA would have understood those structures to be the same or at least similar, despite the difference in reference numerals.

62. Instead of focusing on the different reference numerals, a POSITA would have understood that Iwamiya's light shielding frame 18 and the holder portion 43 in other embodiments are analogous structures and that Iwamiya's teachings regarding how to accomplish light shielding for the holder portion 43 apply equally to the light shielding frame 18. Iwamiya's figures show that the light shielding frame 18 and holder portion 43 are located in the same position with respect to their embodiments. *See* EX1004, Figs. 3, 13 (annotated below).



Moreover, that they both serve the same purpose of holding the optical filter in front of the light receiving unit, and are both described as light shielding. *Id.* 8:38-42, 18:51-55, 18:61-65; *see also id.* at Figs. 16, 19, 28:52-63, 39:9-19. Nothing in Iwamiya would have suggested to a POSITA that information about one embodiment cannot be used with another embodiment. Thus, a POSITA would have understood Iwamiya's teachings with respect to the holder portion 43 and its use of metal to accomplish "light shielding" speak directly to how the light shielding frame 18 would have been implemented. Indeed, Apple's Petition conflated the two

structures, further confirming that a POSITA would have viewed them as analogous structures. Pet., 10 (“Further, a POSITA would have known that a light shielding frame 18 or holder portion 43 as disclosed by Iwamiya can be of various proportions, materials, and that a thin surface could be coated.”). Thus, a POSITA would have had no reason to look beyond Iwamiya to a completely different reference like Sarantos for a material to implement Iwamiya’s light shielding frame.

63. I understand the Institution Decision stated, “although Iwamiya describes its light shielding frame as opaque, it does not speak to how its opacity is achieved, i.e., what materials and/or coatings are employed in order to render its frame opaque.” Inst., 28. The Board then stated, “We view Petitioner’s proposal to use Sarantos’s specific materials, i.e., in-mold label or other masking techniques, as implementing the opacity of Iwamiya’s light shielding frame rather than adding to it.” *Id.* But Iwamiya does not disclose the use of a coating on the light shielding frame 18 at all. *See* EX1004, 8:38-42. Apple’s argument therefore is based on adding a coating that was not disclosed in Iwamiya. If Iwamiya were silent as to the material of the light shielding frame 18 (and as I explained above, it is not silent), then a POSITA would have looked for a material to provide the structure of frame 18, not a coating.

64. The Board’s reasoning in the IPR2022-01291 final written decision skipped the step of answering what material the frame 18 would be made from and

went to the conclusion that a POSITA would have chosen a dark-colored coating from Sarantos. EX2096, 38-39; Inst., 26-28. But that reasoning does not explain why a POSITA would have considered a coating in the first place. Instead, the reasoning that a POSITA would have selected a coating for Iwamiya's light shielding frame is like a building contractor selecting paint because a blueprint did not specify what material a wall is made of. Notably, the Board also ignored Iwamiya's disclosure that metal provides a light shielding property because Iwamiya did not "teach away from using an absorptive material" and did not identify a "particular benefit" from using a reflective material. EX2035, 40-41. But that reasoning relied on hindsight to ignore Iwamiya's disclosure and to turn to a different reference. Without the benefit of hindsight, a POSITA would have understood that (1) Iwamiya described a "light shielding frame 18" and (2) disclosed metal, such as aluminum, as providing a "light shielding property." EX1004, 18:61-64. If Iwamiya were silent about the material of the "light shielding frame 18" (and it is not), a POSITA would have had no reason, other than hindsight, to look beyond Iwamiya's disclosure that metal accomplishes "light shielding."

65. I note that in IPR2022-01291, the Board stated that "the fact that Sarantos's dark-colored coating is disposed within a translucent or transparent material ... does not negate Apple's motivation, because Iwamiya does not limit the material or structure to be used in light shielding frame 18." EX2096, 40. But that

is incorrect because Iwamiya's description of "light shielding frame" indicates the frame is made of an opaque material rather than a translucent or transparent material. A POSITA would have understood that a frame made of a translucent or transparent material would be inconsistent with Iwamiya's description that the frame itself is a "light shielding frame." Moreover, Sarantos uses its in-mold label or mask to form window regions in a window. EX1005, Fig. 22, 17:1-25. It does not suggest using a dark-colored coating on a frame like Iwamiya's light shielding frame, or suggest using a translucent or transparent window as a frame.

66. Accordingly, a POSITA would have understood that Iwamiya's light shielding frame 18 is already opaque, without the need to add a separate coating to accomplish that function. A POSITA therefore would not have had a motivation to then further add a dark-colored coating from Sarantos to the frame. Such a modification would have been unnecessary and redundant. A POSITA would not have identified a need to perform such a modification. Without using the '159 Patent's claim language as a guide, a POSITA would not have been motivated to make this modification.

67. It is also my opinion that a POSITA would not have been motivated to add a dark-colored coating to Iwamiya's light shielding frame 18 to achieve some benefit. Apple argues there would have been various benefits to adding a dark-colored coating, but each of Apple's theories fail to demonstrate any benefit that a

POSITA would recognize would be gained by adding a dark-colored coating to Iwamiya's existing light shielding frame.

68. For example, Apple argues that a “coated light shielding frame has improved characteristics for shielding the photodiodes from stray light, thereby minimizing the amount of light that reaches the photodiodes 9 from LEDs 6 *without first being reflected off the user's skin.*” Pet., 9. However, a POSITA would not have been motivated by this reasoning because it is *not* the function of the light shielding frame to minimize light from the LEDs that reaches the photodetector without first being reflected by the user's tissue. The light shielding frame 18 is situated in a cavity separate from the LEDs and any light that would reach the light shielding frame 18 would have needed to enter first from the user's tissue and in through the scattered light taking unit 8, as shown in Iwamiya's Figure 4 below. Thus, the light shielding frame 18 does not play a role in preventing light from the LEDs from reaching the photodiode 9 without first being reflected off the user's skin.

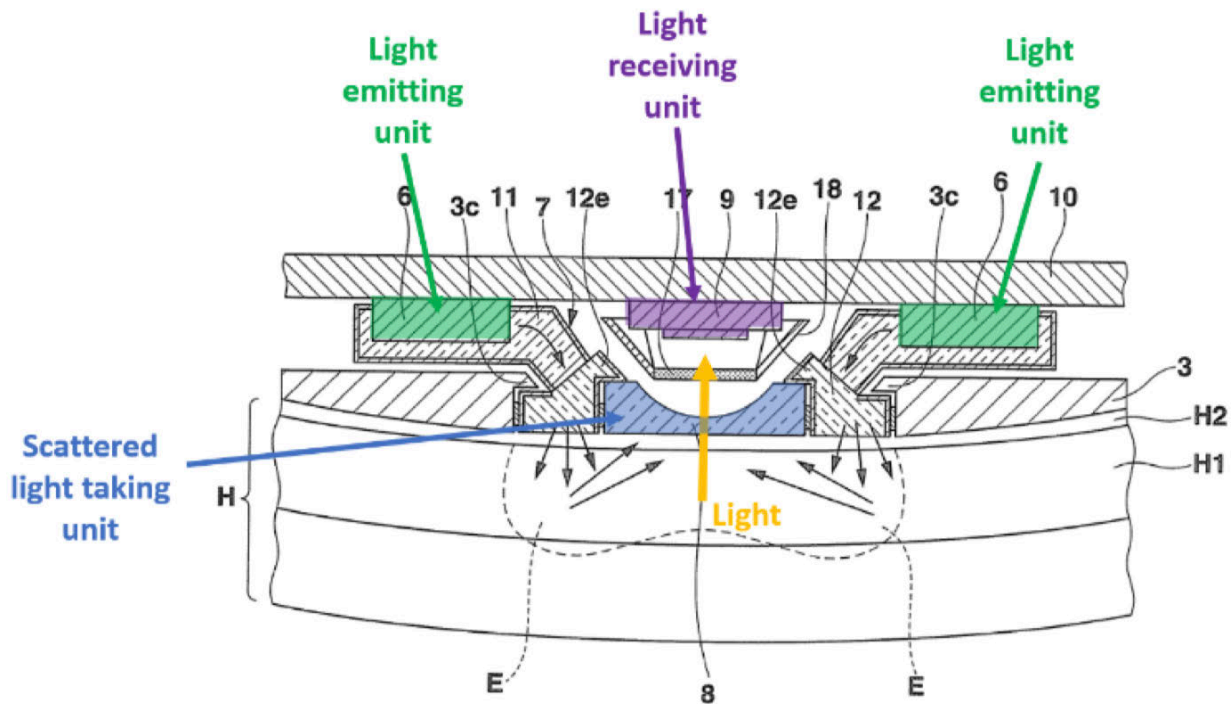


FIG. 4

69. Indeed, Apple itself argued that this is a totally separate function that is unrelated to the light shielding frame. Specifically, Apple argued that it is the purpose of a different structure in Iwamiya—the “reflection layers 13 and 15”—to “prevent at least a portion of the light emitted from the one or more emitters ... from reaching the plurality of detectors ... without first reaching the tissue.” Petition, 28. In fact, Apple argued in a related Petition that the function of the reflection layers 13 and 15 would not inform a POSITA’s understanding about the light shielding frame 18 because it has a different function. Specifically, Apple argued:

Indeed, the function of reflection layers is generally different from light shielding frame 18, which is specifically designed to shield light from

reaching the photodiodes 9. APPLE-1004, 8:38-42. Iwamiya even refers to frame 18 and reflecting layers, e.g., reflection layers 13 and 15, by different terminology, thereby *underscoring differences in their respective functions*.

IPR2024-00241 Pet., 17. Thus, under Apple’s analysis, a POSITA would not have been motivated to add a dark-colored coating to the light shielding frame to minimize the light from the LEDs that reaches the photodetector without first being reflected off the user’s tissue because that is not the function of the light shielding frame.

70. Apple also argues that using a dark-colored coating on the light shielding frame would have been beneficial because it absorbs light, rather than reflecting light. Petition, 9, 12. Apple argues that a dark-colored coating “would have reduced the amount of arrant [sic] light that could reflect back through the empty space and the optical filer [sic] 17 to the photodiodes” and that a “POSITA would have sought to reduce these effects since any light that reflected back from the space surrounding frame 18 and through the optical filter 17 to the photodiodes would have different path lengths that could increase optical interference and reduce measurement accuracy.” Petition, 12. That is incorrect because (1) Apple and its expert cited no evidence that a POSITA would have recognized such a motivation, (2) Apple appears to have relied on the ’159 Patent’s specification to provide the motivation, and (3) Apple ignores that Iwamiya’s sensor design causes reflections all throughout the sensor.

71. Regarding (1), Apple does not cite any evidence that demonstrates that reflections within a sensor cavity can cause pathlength variations as a potential source of error. Petition, 11–12. Apple relies on excerpts from Webster (EX1009), but those cited sections do not support Apple’s theory. *See* Petition, 11–12 (citing EX1009, 69, 96–97)<sup>5</sup>. Page 69 of Webster discusses light scattering *in blood*, not inside the empty space of a sensor cavity. EX1009, 69. That page explains “Multiple scattering increases the optical path length and therefore increases the absorbance.” *Id.* That is a separate and distinct issue from light reflecting inside an empty sensor cavity because there is no blood inside Iwamiya’s sensor cavity to further absorb the red and infrared light of interest. Pages 96–97 of Webster also do not support Apple’s theory. Those pages discuss “two types of optical interference that may cause problems for the photodiode.” EX1009, 96. Webster explains that “[t]he first is excessive ambient light” and “[t]he second source of interference is optical cross-talk” which “may occur when multiple probes are used in close proximity” and “light from one LED probe is sensed by the photodiode of another probe.” *Id.* Thus, Webster does not support Apple’s alleged motivation to reduce reflections due to a pathlength variation

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<sup>5</sup> Apple’s citations to this exhibit were to the PDF page numbers, not the original page numbers. *See* Petition at 10 n.2. I also refer to the PDF page numbers in this paragraph.

problem. Dr. Anthony's declaration also does not cite any support for this theory. *See* EX1003, ¶¶36, 42. His declaration sets forth the same argument and the same citation to Webster that I discussed above. Dr. Anthony also includes an additional citation to Schulz (EX1032), which is not referenced in the Petition. *See* EX1003, ¶36 (citing EX1032, 1:65–2:16, 9:58–10:23). However, those sections of Schulz also discuss ambient light and emitted light bypassing the tissue. *See* EX1032, 1:65–2:16, 9:58–10:23. They do not discuss pathlength variations caused by reflections inside a sensor. Thus, Apple has identified no prior art that would have suggested to a POSITA to use a dark-colored coating to reduce pathlength variations caused by light reflecting inside a sensor.

72. Regarding (2), Apple apparently relied upon the '159 Patent's own disclosures to provide the alleged pathlength motivation. The '159 Patent taught the use of a dark-colored coating to prevent pathlength variations that might occur when light reflects back and forth between the sensor and the user's tissue. *See* EX1001, 8:54–9:7. It is these reflections that can cause accuracy problems because the light would have varying amounts of light absorption by the user's tissue based on the different pathlengths through the tissue. *Id.* Apple apparently relied on this pathlength disclosure from the '159 Patent, because it did not identify any other reference that disclosed the same problem and solution. I understand that would be improper hindsight reasoning, which cannot demonstrate obviousness. But Apple

also apparently misapplied the '159 Patent's teachings to the empty space inside Iwamiya's cavity, where there is no tissue.

73. Regarding (3), Apple's alleged motivation to reduce reflections inside Iwamiya's sensor cavity does not make sense because if such reflections were recognized as an issue, a POSITA would have disregarded Iwamiya entirely. Iwamiya's sensor design *relies* on light reflecting around inside the sensor. Specifically, Iwamiya uses a light guide 7 which is coated with reflection layers 13 and 15. As shown below, light from the emitters 6 reflect around within the light guide.

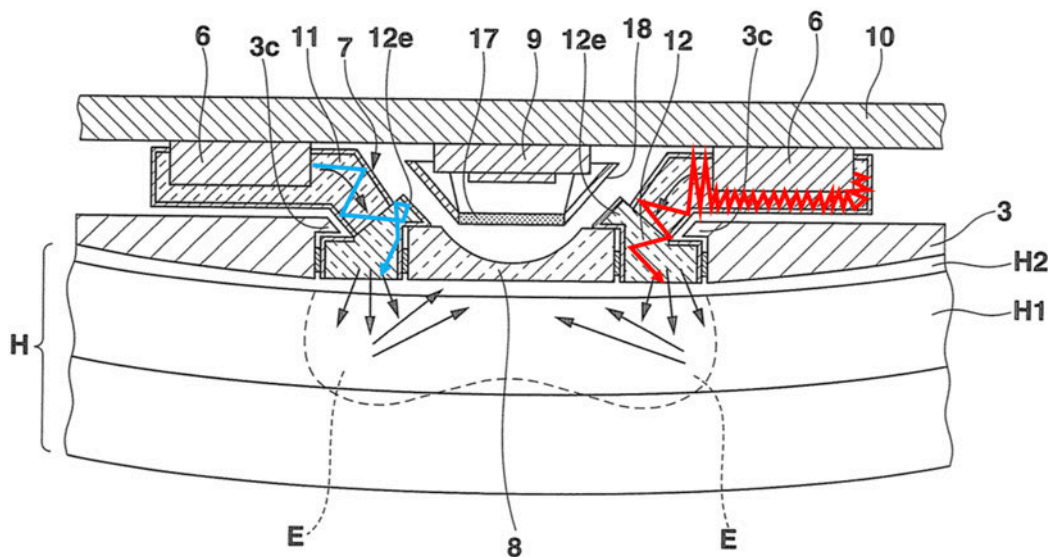


**FIG.4**

EX1004, Fig. 4 (annotated) (Note: Iwamiya's light guide is a 3D object, thus light would actually be reflecting around and scattering within the light guide in a more

complex manner than illustrated in 2D above). As shown by the blue and red annotations, light reflects around the light guide in order to reach the user's tissue. Apple's suggestion that a POSITA would want to avoid reflections within a sensor is inconsistent with Iwamiya's design. A POSITA therefore would not have recognized any motivation to add a dark-colored coating to the existing light shielding frame to address reflections.

74. Apple also argues that “the selection of a dark-colored, light-absorbing material to coat frame 18 [would] be a simple matter of design choice given that light-shielding materials must either absorb or reflect light, and the use of a ‘dark’ coating would be particularly obvious to absorb the broadest spectrum of light.” Petition, 10. However, Iwamiya does not leave the choice of an appropriate coating to the POSITA because Iwamiya does not disclose any coating on the frame 18 at all. EX1004, 8:38–47. Apple seeks to add a layer of coating to Iwamiya's existing frame, where there was no coating before. A POSITA therefore would not have been faced with a “design choice” between which type of coating to use.

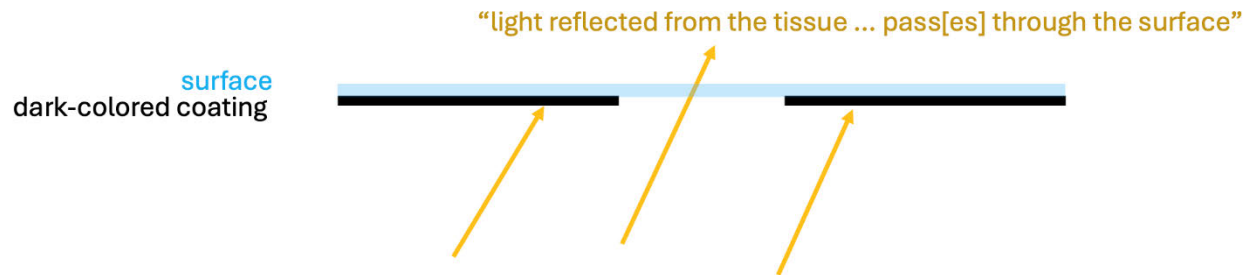
75. For at least the reasons I explained above, a POSITA would not have been motivated to further add a layer of dark-colored coating to Iwamiya's light shielding frame. Accordingly, a POSITA would not have combined Iwamiya and Sarantos. Thus, Apple fails to demonstrate that Claims 1 and 19 and their dependent claims would have been obvious.

**C. The Iwamiya-Sarantos Combination Does Not Have an “Opening Defined in the Dark-Colored Coating” that Allows Light to “Pass Through the Surface” (Claims 1 and 19)**

76. The Iwamiya-Sarantos combination does not disclose an “opening defined in the dark-colored coating” configured to allow light to “pass through the surface.” Apple’s invalidity theory identified Iwamiya’s light shielding frame 18 as the recited “surface.” *See* Petition, 21 (“[T]he Iwamiya-Sarantos combination includes a ‘light shielding frame 18’ (the claimed ‘surface’) surrounding the photo diodes/light receiving units 9...”)). However, in the Iwamiya-Sarantos combination, light does not pass through the light shielding frame 18 and thus does not “pass through the surface.”

77. To elaborate, Apple argues that a POSITA would have applied a dark-colored coating from Sarantos to Iwamiya’s light shielding frame 18. *See* Petition, 21. Apple then relies on the optical filter 17 as the “opening.” *See id.* at 23–24. But the optical filter is not an “opening defined in the dark-colored coating” which is configured to allow light to “pass through the surface.” Rather, the optical filter is a different structure which is mounted to the light shielding frame. *See* EX1004, 8:38–42 (“[A]n optical filter 17 is disposed in a state where the optical filter is mounted on the lower side of a light shielding frame 18 to surround the light receiving unit 9.”). Light does not “pass through the surface” because the light shielding frame is absent where the optical filter is located.

78. Additionally, the optical filter does not permit light to “pass through the surface” (i.e., the light shielding frame) as required by the claim. The plain language of the claims requires that light “pass through the surface”—in other words, through the light shielding frame, for example as shown below.



“a **surface** comprising a **dark-colored coating**, the surface positioned between the plurality of detectors and the tissue when the physiological monitoring device is in use, wherein an opening defined in the dark-colored coating is configured to allow at least a portion of **light reflected from the tissue to pass through the surface**”

79. The surrounding claim language confirms this interpretation of the claims. The claims require a “*surface* comprising a dark-colored coating.” A POSITA would have understood that the “surface” and the “coating” are distinct claim elements. The surface comprises a coating, but the surface and coating are not one and the same because a coating, like paint, has to be applied to a surface—it does not exist on its own without some structure. Additionally, the claim limitation requires an “opening defined *in the dark-colored coating*,” rather than an opening defined in the *surface*. The limitation then requires the opening be configured to allow light to “pass through *the surface*.” Thus, a POSITA would have understood that the claim requires light to pass through the surface that the coating is applied on.

80. In the Institution Decision, the Board stated that its “ultimate resolution of this issue will likely turn on whether the claim requires light to actually penetrate the ‘surface’ it passes through (as Patent Owner implicitly contends) or whether it is instead sufficient that light is allowed to pass through an opening in the surface (as Petitioner implicitly contends).” Inst., 33. A POSITA would have understood that it is not sufficient that light passes through an opening in the surface because the claimed opening is “defined in the dark-colored coating,” not the “surface,” and the opening must allow light to “pass through *the surface*.” Apple’s proposed Iwamiya-Sarantos combination therefore does not disclose limitations [1.5] and [19.5] because light does not transmit through the light shielding frame 18, which Apple identified as the “surface” that would be coated. Moreover, the optical filter 17 is not an “opening defined in the dark-colored coating” because it is a separate structure mounted to the light shielding frame.

**D. Determining Oxygen Saturation At The Wrist Would Not Have Been Obvious To A POSITA (Claims 8 and 17)**

81. I understand that Claims 8 and 17 depend from Claims 1 and 14, respectively, and add the limitation, “wherein the physiological parameter comprises oxygen saturation.” However, determining oxygen saturation at the wrist, as opposed to determining oxygen saturation from conventional locations like the finger or forehead, would not have been obvious to a POSITA in 2015.

1. **Neither Iwamiya Nor Sarantos Disclose Measuring Oxygen Saturation**

82. Iwamiya and Sarantos do not disclose determining oxygen saturation at a user's wrist. Iwamiya does not disclose oxygen saturation measurements at all. Instead, Iwamiya discloses the use of only a single wavelength of infrared light at 940 nm. EX1004, 10:34-38, 11:19-23. A POSITA would have understood that does not disclose oxygen saturation measurements because oxygen saturation requires at a *minimum* two wavelengths of light, typically red and infrared, in order to measure the differences in absorption by hemoglobin and oxyhemoglobin. There are no known techniques for measuring oxygen saturation using only a single wavelength of light. Thus, Iwamiya does not and cannot disclose measurement of oxygen saturation.

83. Sarantos also does not disclose determining oxygen saturation at the wrist. The Petition relies on Sarantos' passing mention of oxygenation levels and "red *or* infrared" light. Pet., 38-39 (citing EX1005, 13:44-58, 18:44-48). There, Sarantos states, "photoplethysmographic techniques may also be used to measure other physiological parameters besides heart rate, such as blood oxygenation levels. It may, in such situations, be desirable to utilize an LED that predominantly emits light in the red or infrared spectrum for such purposes." EX1005, 13:44-49. But a POSITA would have recognized that Sarantos's reference to "red or infrared" light does not disclose the measurement of oxygen saturation. Sarantos used a disjunctive

“or” when referencing “red or infrared” light. EX1005, 13:44-57. But oxygen saturation is not performed using “red or infrared light.” It uses both red *and* infrared light. Thus, Sarantos’s disclosure does not disclose the measurement of oxygen saturation.

84. Moreover, Sarantos confirms that its disclosure is not tailored for the red and infrared light used for oxygen saturation. Sarantos discloses “high-aspect-ratio” (HAR) photodetectors to provide “improved signal-strength-to-power consumption performance” for pulse rate sensors. EX1005, Abstract, Fig. 2. But Sarantos explains that its disclosure is “discussed primarily with respect to light sources that emit green light, e.g., wavelengths in the range of 500 nm to 550 nm, although it is contemplated that the photodetector element concepts discussed herein may see similar performance with light sources that emit light predominantly in the 500 nm to 600 nm range, which includes yellow light as well as some light orange light.” EX1005, 18:35-41. Sarantos then explains that, “[i]n contrast, other photoplethysmographic techniques, such as techniques for measuring blood oxygenation levels, may be most effective using light of dramatically different wavelengths, such as in the red wavelengths, e.g., 660 nm, or in the infrared spectrum.” *Id.*, 18:44-48. Sarantos then admits that “[t]he aspect ratios and dimensional values discussed herein are tailored based on the green/yellow light spectrum and are not tailored for use in other spectrums, such as the red or infrared

spectra.” *Id.* at 18:48-51. Based on this disclosure, a POSITA would have understood that Sarantos does not disclose oxygen saturation measurements at the wrist. Instead, Sarantos merely mentions oxygen saturation while leaving it up to the reader to figure out how to actually accomplish it.

**2. A POSITA Would Not Have Been Motivated to Combine Iwamiya and Sarantos**

85. Apple argued that a POSITA would have modified Iwamiya to measure oxygen saturation in order “to expand the range of physiological parameters measured by Iwamiya’s sensor, thereby improving the functionality and utility of the sensor.” Pet., 39. But this alleged motivation is completely generic and says nothing more than it would have added a feature to Iwamiya. That reasoning is insufficient to provide a motivation to modify Iwamiya to measure oxygen saturation.

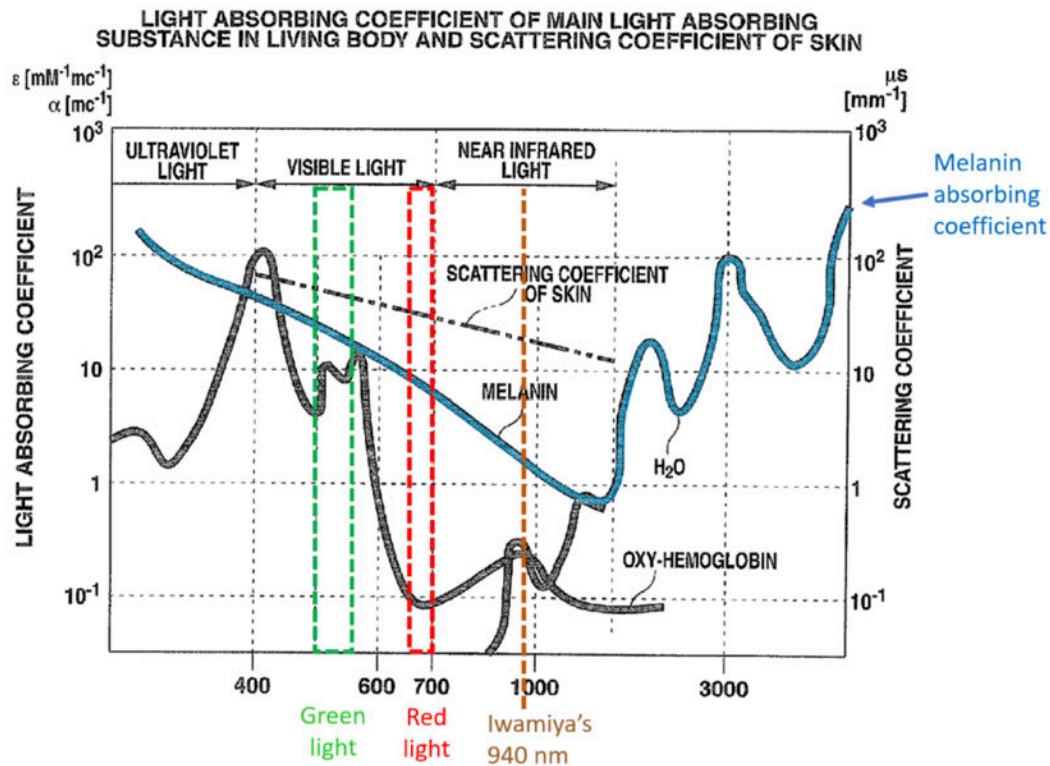
86. Apple also argued that adding oxygen saturation measurements to Iwamiya would have removed the need for a separate device to measure oxygen saturation and would have allowed users to check their oxygen saturation. Pet., 39-40. Apple listed “[p]eople with cardiac or pulmonary disease,” “pilots,” and “alpinists,” as types of people who would want to check their oxygen saturation. *Id.* But Apple’s argument relies on circular logic and adds nothing more to the analysis than simply stating that adding an oxygen saturation feature would allow a user to measure their oxygen saturation. I also note that Apple argued that the modification would provide a “safe, reliable, real time and continuous measurement” of oxygen

saturation and that oxygen saturation could be measured “while jogging or exercising.” Pet., 40. But that is not true. As of 2015, a POSITA would not have expected to have been able to measure oxygen saturation from the wrist (as I explain at length below), much less measure oxygen saturation at the wrist continuously through motion. Indeed, as I mention below, Apple’s own lead engineer recognized that there were no such commercial devices as of late 2014 that measured oxygen saturation from the wrist (and there would be none until 2020). EX2076, 962:25-963:9, 964:2-6. In fact, not even Apple’s engineers attempted to solve the problem of measuring oxygen saturation at the wrist through motion. EX2078, 927:19-928:8. And even as of today, the Apple Watch cannot measure oxygen saturation through any motion whatsoever. EX2106, 2 (“Stay still, and make sure your wrist is flat with the Apple Watch facing up.”). To my knowledge, only Masimo has received FDA clearance for a pulse oximeter that measures continuously at the wrist.

87. Apple argued that a POSITA would have modified Iwamiya’s sensor to measure oxygen saturation by “adding one or more red LEDs.” Pet., 42. But Iwamiya teaches away from Apple’s proposal. A POSITA would have understood that Iwamiya repeatedly taught away from the use of visible light, including red light, in its sensor design and included multiple design aspects that were specifically designed to avoid the use of visible light. Iwamiya discloses the use of only a single wavelength of light at 940 nm. EX1004, 10:34-38, 11:19-23. Iwamiya chose that

940 nm wavelength to solve a specific problem where melanin in the skin “has extraordinarily high absorbance in a wavelength band from ultraviolet light to visible light,” resulting in weak signals such that “biological information, such as a pulse wave, cannot be detected.” EX1004, 1:62-2:6, 21:38-22:12, Fig. 6. Iwamiya repeatedly teaches that infrared light at 940 nm avoids the problems associated with melanin in the skin. *See* EX1004, 10:34-38 (“[E]ven though the epidermis H2 contains the large amount of melanine [sic] pigment, the observation light is light of an infrared band of  $\lambda_p=940$  nm. For this reason, the amount of light absorbed by the melanine [sic] pigment is small and the light is securely incident in the dermis H1.”); *id.* at 6:31-34, 11:43-49, 15:26-29, 20:51-55, 21:62-67, 22:24-31, 32:57-60, 42:44-48, 43:57-44:20.

88. Iwamiya also goes to great lengths to avoid light below 900 nm, which includes visible light, and dedicates substantial disclosure to teaching against using visible light. For example, Iwamiya’s Figure 6 illustrates the “extraordinarily high absorbance” of melanin in the visible spectrum.



EX1004, Fig. 6 (annotated). In Iwamiya's Figure 6 above, the melanin absorption coefficient (highlighted blue) is shown on a logarithmic scale. The figure shows that the absorption coefficient for green light (green dashed box) is approximately 20 times higher than that at 940 nm (brown line) and approximately eight times higher in the red spectrum (red dashed box) than at 940 nm.

89. Iwamiya also specifically designed other aspects of its sensor design for use with 940 nm infrared light. For example, Iwamiya explains that its light receiving unit has a peak sensitivity to light at 940 nm and significantly less sensitivity for other wavelengths. EX1004, 8:29-37, Fig. 9. As shown in Figure 9, the relative sensitivity of the light receiving unit for green wavelengths (500-550 nm)

is only between 15-25% of the peak sensitivity at 940 nm and the relative sensitivity for red wavelengths 660-700 nm (red dashed box) is only around 50-60% of the peak sensitivity at 940 nm. Thus, Iwamiya's sensor has very little sensitivity to measurements of light in the visible spectrum and was not designed for taking such measurements.

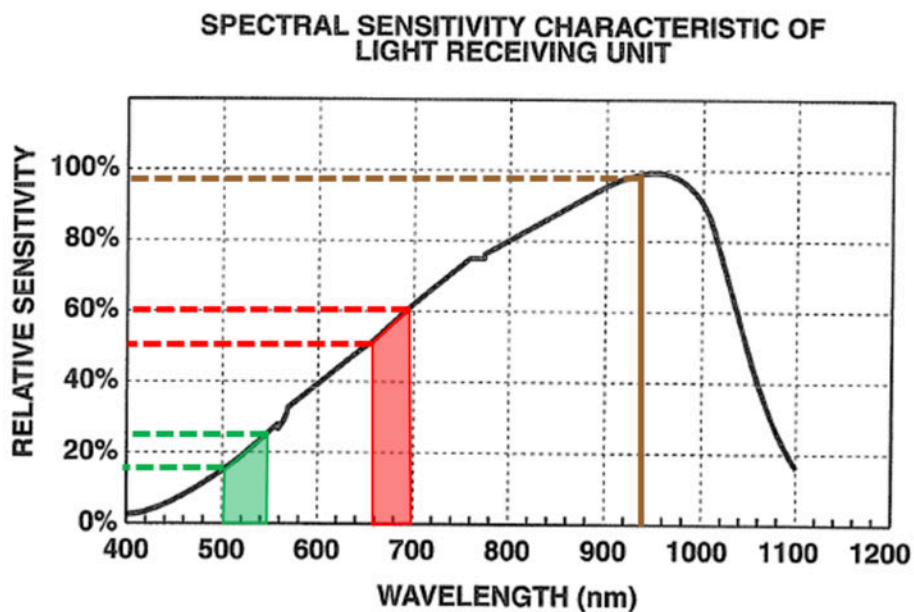
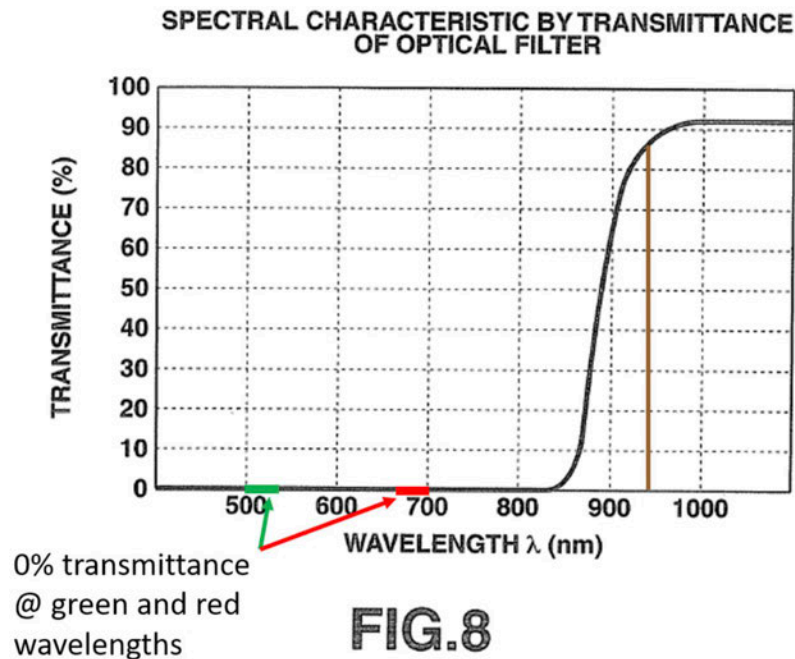


**FIG. 9**

EX1004, Fig. 9 (annotated).

90. Because Iwamiya taught against using visible light, Iwamiya includes a filter which only transmit light above 900 nm and filters out light below 900 nm (which includes visible light). EX1004, 8:38-47, Fig. 8. Iwamiya describes that this is done in part to avoid measurement changes due to external light. EX1004, 4:26-27, 8:38-47, Figs. 3-4, Fig. 8. Iwamiya's Figure 8 shows that its filter has 0%

transmittance for visible light, including for green and red light. This means that no visible light would be able to pass through the filter.



EX1004, Fig. 8 (annotated).

91. Based on these disclosures, a POSITA would have understood that Iwamiya taught away from the use of visible light, including red light, in its sensor due to weak signal problems. Apple's proposal would require a POSITA to ignore all of Iwamiya's teachings that were emphasized numerous times throughout Iwamiya's specification and proceed directly against them. *See* Pet., 42 (arguing a POSITA would add red LEDs, change the photodiodes, and change the optical filter). A POSITA therefore would not have been motivated to modify Iwamiya to use red light as Apple argued as it would have been directly contrary to Iwamiya's teachings.

92. I understand that in IPR2022-01291, the Board stated that “to the extent Iwamiya teaches away from using visible light such as red light in its device, this teaching away applies only to users having ‘a large amount of melanin[] pigment’ in their skin, ‘for example, in the case of a person of dark skin color.’” EX2096, 65. The Board then concluded that “so far as Iwamiya is concerned, using visible observation light in a biometric sensor will work for users having less than a ‘large amount’ of melanin in their skin.” *Id.* The Board concluded that this would have been a “*suitable* option.” *Id.* (original emphasis). But Iwamiya does not support the idea that its sensor design would work when using red light. Instead, as discussed above, Iwamiya went to great lengths detailing the problems with using visible light and how such light would be “weak light and cannot be sufficiently received,” such that “biological information, such as a pulse wave, cannot be detected.” EX1004, 1:64-2:6. Moreover, a POSITA reading Iwamiya’s repeated teachings away from using visible light due to problems with melanin in the skin would not have somehow found it “suitable” to modify Iwamiya and develop a device that might only work on persons with light skin color, but stop working at some unknown skin tone. Instead, a POSITA would have understood that biases in medicine among different groups of people is a problem to be addressed—that was the whole point of Iwamiya’s disclosure. A POSITA would not have thought developing a device that only works for certain skin tones would be “suitable.” Iwamiya criticized and taught away from

the use of visible light in its sensor because melanin in the skin would create signal issues for many users.

93. The Board's IPR2022-01291 final written decision also dismissed Iwamiya's teaching away as being limited to the context of determining heart rate, not oxygen saturation. EX2096, 68 ("Iwamiya discloses using its device only for determining heart rate, with infrared light of 940 nm, so *in that context* Iwamiya configures the filter to remove wavelengths of less than 900 nm.... A [POSITA] would have appreciated that, when improving Iwamiya's device to determine heart rate and blood oxygen saturation by using red light in addition to infrared light, the filter would be modified to pass red and infrared light ...."). That reasoning is incorrect because determining oxygen saturation involves analyzing two simultaneous PPG signals generated from red and infrared light. Moreover, determining oxygen saturation is significantly more difficult and complicated than determining heart rate (which can be done by counting the peaks in a PPG signal). Instead, high quality PPG signals are needed for pulse oximetry in order to distinguish the absorbance of pulsatile arterial blood from non-pulsatile venous blood. *See, e.g.*, EX1013 at 13-14, 35. Thus, a POSITA would have understood that Iwamiya's teaching away from using visible light due to signal issues is even *more* applicable in the context of oxygen saturation. Accordingly, a POSITA would not have been

motivated to modify Iwamiya's device with red light to measure oxygen saturation because Iwamiya expressly taught away from that modification.

**3. A POSITA Would Not Have Had a Reasonable Expectation of Success in Determining Oxygen Saturation at the Wrist as of 2015**

94. Apple argued that a POSITA would have had a reasonable expectation of success modifying Iwamiya to measure oxygen saturation because “wrist-worn pulse oximetry sensors, such as that described in Sarantos, were well-known in the art.” Pet., 41. But in 2015, there was no such thing as a wrist-worn pulse oximetry sensor “such as that described in Sarantos.”

95. Sarantos is a patent filed by and assigned to Fitbit, Inc., a company well-known for making wearable fitness trackers. EX1005, Cover. But there was no Fitbit device in existence as of July 2015 that could measure oxygen saturation at the wrist. Instead, Fitbit only first released such a device in 2020. EX2091, EX2092. And far from being routine, pulse oximetry at the wrist was described by Fitbit's research director as “a pretty hard technical problem.” EX2088, 4.

96. Similarly, in 2014, a company called Withings released a wrist-worn device called the Pulse O2. EX2095. Yet the Withings Pulse O2 could not measure oxygen saturation from the wrist. Instead, the user was required to remove the device from its wrist strap and place the device on a finger to measure oxygen saturation, which a reviewer called “seriously annoying.” EX2095, 3-5.

97. Apple’s own lead engineer, Brian Land, also testified during the ITC Investigation that when Apple began developing an oxygen saturation sensor for the wrist in 2014, measuring oxygen saturation at the wrist was “unprecedented” and “there were no commercially available products that did blood oxygen sensing at the wrist.” EX2076, 962:25-963:9, 964:2-6. Thus, wrist-worn pulse oximeters were not well-known in 2015 so as to have been routine. They did not yet exist.

98. Apple further argued that “a POSITA would have recognized the conventional nature of basic pulse oximetry techniques that had been known for decades before the ’159 Patent ... and it would have been well within the ordinary skill and creativity of a POSITA to implement such a device.” Pet., 43. But the testimony of Apple’s engineers further confirms that a POSITA would not have had a reasonable expectation of success in modifying the prior art to determine oxygen saturation from the wrist as of July 2015. In late 2014, Apple hired Dr. Paul Mannheimer [REDACTED]

EX2076, 962:15-963:15, EX2094, 17:1-14. Apple hired Dr. Mannheimer specifically for his [REDACTED]

[REDACTED] EX2076, 954:15-955:9, 963:5-15; EX2077, 996:25-997:8. Mannheimer holds a Ph.D. in biomedical engineering and had spent over twenty years designing pulse oximeters at one of Masimo’s major competitors, Nellcor, and considered his specialty to be the physio-optics of pulse oximetry.

EX2077, 994:2-25, 1009:1-8, EX2080, 180:22-181:5. Upon hiring, Apple tasked Mannheim to [REDACTED]

[REDACTED] EX2080, 173:9-173:13; EX2077, 1012:12-25. Mannheim testified, “My first reaction when actually hearing it was internally to my head rolling my eyes, thinking, as I’d thought of it in the past with other clients, like good luck with that.” EX2080, 173:14-174:1, EX2077, 1012:12-25. Mannheim even told his boss, “that’s going to be a challenge” and “I don’t know if it can be done.” EX2080, 174:2-6.

99. Mannheim also explained why measuring oxygen saturation at the wrist would be challenging. He testified:

[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED] [REDACTED]  
[REDACTED]  
[REDACTED]

EX2080, 174:7-18; EX2077, 1012:12-1013:6; *see also* EX2077, 998:21-999:11 (products Mannheim worked on previously “operated on a much more vascularized tissue bed, usually fingers or forehead” and “the wrist is just an incredibly different beast”). Mannheim also explained that before 2015, he had placed probes on the

wrist and found that he could not get it to measure oxygen saturation. EX2094, 19:10-20.

100. Other Apple engineers also testified similarly, confirming the lack of any reasonable expectation of success at the time. For example, Dr. Stephen Waydo led Apple's team of engineers in developing the pulse oximetry algorithm. EX2078, 919:1-8. Dr. Waydo spent four and a half years at a medical device startup trying to build a noninvasive glucose measuring device before working at apple. *Id.* at 920:3-6. Waydo testified that he was [REDACTED] when he received the assignment to help develop the blood oxygen feature for the Apple Watch. EX2078, 938:3-15. Waydo also explained that it was "extremely challenging" to develop the blood oxygen feature for the Apple Watch. *Id.*, 938:21-24. He explained that "[t]he wrist is one of the most difficult places on the body to do almost ever physiological measurement" and that [REDACTED]

[REDACTED] EX2081, 166:4-16. Waydo explained that [REDACTED]

[REDACTED] EX2078, 923:24-924:4. He further testified that his team of engineers were "just a small piece of the overall puzzle," yet they spent "something like 20 or 30,000 hours of engineering time just on that [oxygen saturation] algorithm architecture." EX2078, 919:1-8, 925:23-926:6.

101. Another Apple engineer, Dr. Tao Shui, who also helped developed the blood oxygen saturation feature in the Apple Watch also testified:

The most challenging part of the work is related to the position of the Apple Watch blood oxygen sensor. The watch is worn on the wrist, and the wrist is well known for its lack of signal. [REDACTED]

[REDACTED]

[REDACTED]

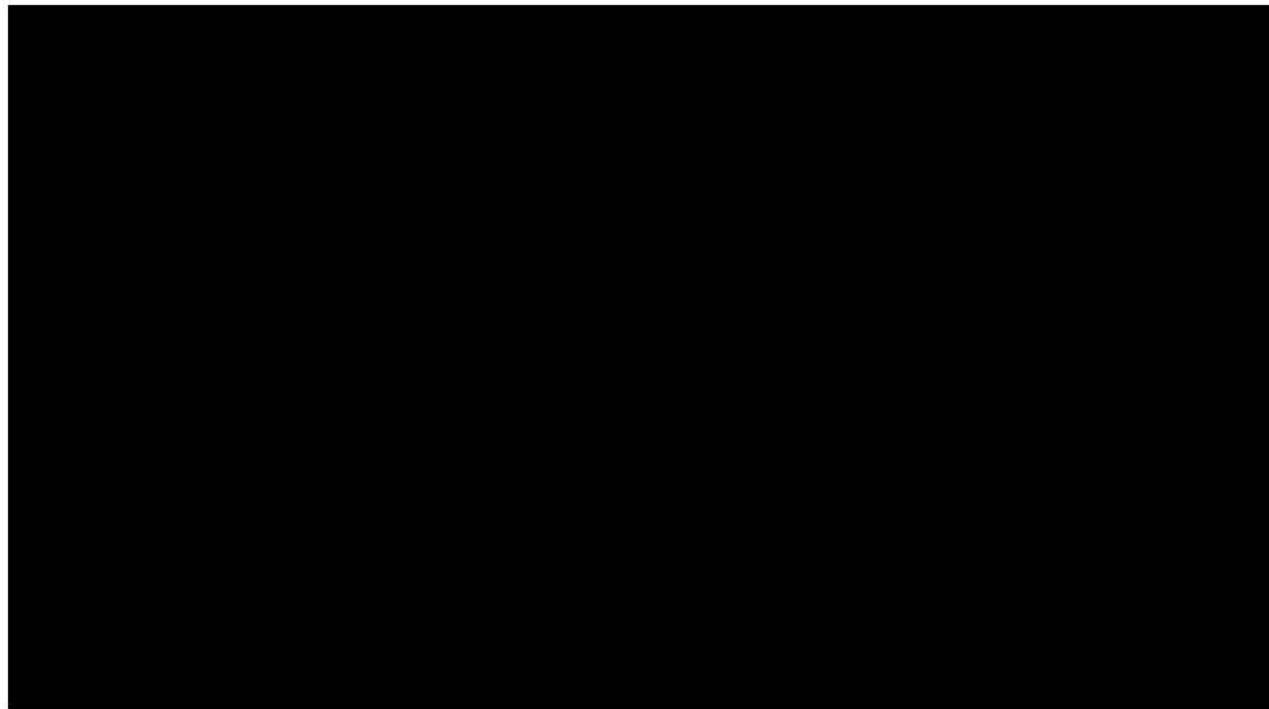
EX2082, 108:13-21.

102. Apple's internal development documents are also consistent with Apple's engineers' testimony. For example, Brian Land testified that the initial team of Apple engineers that worked on the blood oxygen sensor project were himself, Dr. Mannheimer, and another engineer, Albert Cerussi. EX2076, 962:25-963:4. Those engineers presented an internal status update presentation dated July 30, 2015 (just four weeks after the '743 Patent's priority date), detailing their investigation into the feasibility of measuring oxygen saturation at the wrist. EX2085; EX2076, 981:19-983:1, 989:21-990:9. Apple's engineers investigated whether conventional methods of pulse oximetry, [REDACTED]

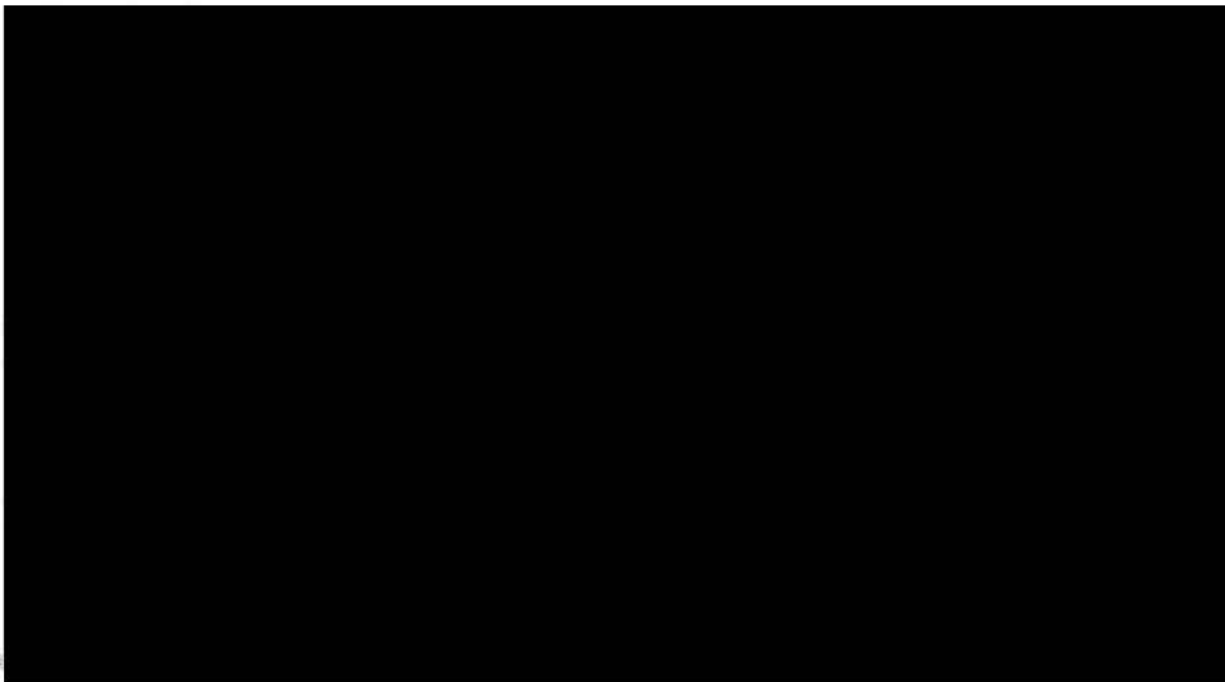
[REDACTED] could work at the wrist. EX2085, 7. They determined those conventional methods would not work at the wrist.

[REDACTED]

[REDACTED] *Id.* 7-9.



EX2085, 8.



*Id.* at 9.



[REDACTED] *Id.* [REDACTED]

[REDACTED] *Id.* at 9.

103. Apple’s engineers even remarked that “Conventional sensing methods do not result in waveforms that are consistent enough for SpO<sub>2</sub> measurements at the wrist.” EX2085, 13. They concluded that “**Invention is required:** [REDACTED]

[REDACTED] *Id.* And [REDACTED]

[REDACTED] EX2085, 13; EX2094, 79:11-80:1. Further

demonstrating the lack of any reasonable expectation of success, Apple’s engineers even questioned, [REDACTED] EX2085, 13. They were not even sure of [REDACTED] *Id.* Apple’s engineers’

conclusions are directly contrary to Apple’s argument that “a POSITA would have recognized the conventional nature of basic pulse oximetry techniques that had been known for decades ... and it would have been well within the ordinary skill and creativity of a POSITA to implement such a device.” Pet., 43.

104. Additionally, Mannheimer explained that during their 2015 research, Apple’s engineers were not yet measuring oxygen saturation at all, but were instead

[REDACTED] between the red and infrared signals. EX2094, 26:2-28:2. But even then, Mannheimer explained that they were getting [REDACTED]  
[REDACTED]  
[REDACTED] EX2094, 28:3-29:19.

105. If measuring oxygen saturation at the wrist were actually “well-known” in 2015 such that a POSITA would have had a reasonable expectation of success, then it should have been no problem for Apple’s engineers to implement such a “well-known” feature into the Apple Watch, which already had a pulse rate sensor. But the testimony of Apple’s engineers confirms that as of July 2015, determining oxygen saturation at the wrist was not routine and there were still [REDACTED]  
[REDACTED] in the way of achieving it. And Apple had hired a team of “world experts who have years of experience designing and shipping PPG sensors” and who had “been there, done that” knowledge, including “which sensor fusion ideas are likely to work, and which ones have been tried and failed (and they know why the failed).” EX2089, 2. The testimony of such highly experienced engineers confirms that a POSITA, with just a bachelor’s degree and a couple years of experience, would not have had a reasonable expectation of success in 2015 in modifying Iwamiya to measure oxygen saturation from the wrist.

106. I understand that in IPR2022-01291, the Board disagreed regarding reasonable expectation of success. The Board stated:

[REDACTED]  
[REDACTED]  
[REDACTED] *Id.*

[REDACTED] Apple's development continued. That fact alone belies Masimo's position that Exhibit 2085 demonstrates a lack of reasonable expectation of success in July 2015. Instead, Exhibit 2085 demonstrates that there were challenges to be overcome in this regard, but those challenges were not so significant as to deter Apple from expecting to succeed in its product development efforts. This same consideration also applies to Apple's engineers' testimony from the ITC Investigation ... who proceeded with their development efforts despite the challenges.

EX2096, 99. I disagree with the Board's reasoning here. Whether [REDACTED] [REDACTED] to continue research and development would have been a business decision and does not reflect whether a *POSITA* would have had a reasonable expectation of success in determining oxygen saturation at the wrist. Instead, Apple's engineers, who exceeded the level of ordinary skill in the art at the time of the July 2015 priority date, expressed that conventional methods of pulse oximetry would not work at the wrist and that invention would be required. EX2085, 13. Those engineers explained that there were still [REDACTED]

In IPR2022-01291, the Board also stated that it “agree[d] with Apple’s argument that, in the context of developing a blood oxygen saturation determination feature in a future iteration of the pre-existing Apple Watch product, the engineers faced various unclaimed constraints that are unrelated to the breadth of claim 9.” EX2096, 100. The Board considered supposed constraints such as the Apple Watch’s “small form factor” and the supposed “desire for the Apple Watch ‘to work across all of the human variation that existed in the world.’” *Id.*, 100-101. The Board also cited testimony from an Apple engineer discussing other features of the Apple Watch, like music, phone calls, Bluetooth, and Wi-Fi connectivity. *Id.* at 100 n.17 (citing EX2076, 970:6-971:6). But these supposed “constraints” had nothing to do with the feasibility testing that Apple’s engineers were conducting in 2015. In 2015, Apple’s engineers were concerned with whether oxygen saturation could be measured from the wrist at all. When Mannheimer was hired by Apple in late 2014, he was tasked with

EX2080, 173:9-13.

EX2085, 12.

107. The Board’s decision in IPR2022-01291 apparently did not appreciate that Apple’s research and development took place in various stages, and as of 2015, Apple was still researching whether oxygen saturation at the wrist was feasible at all. The alleged concerns over “small form factor” and other supposed constraints were not issues until later stages of product development, when Apple’s engineers were working to implement the feature into an Apple Watch. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

EX2085, 12.

108. Accordingly, the testimony of Apple’s engineers was directly related to a reasonable expectation of success for determining oxygen saturation at the wrist. The engineers were not yet concerned with how to fit such a sensor into the Apple Watch—they were concerned with whether it could be done at all. Their testimony, which was based on their experiences and beliefs contemporaneous with the ’743 Patent’s priority date, demonstrates how a POSITA would have actually thought at the time. Apple’s engineers observed that “conventional sensing methods” did not work for oxygen saturation at the wrist. EX2085, 13. They believed “Invention is required” in order to do so. *Id.* And they were so far from success that even Mannheimer, with his decades of experience designing pulse oximeters, questioned [REDACTED] *Id.* A POSITA would not have had a reasonable expectation of success in July 2015.

4. **Apple’s Supporting References Do Not Establish a Reasonable Expectation of Success**

109. Apple cited six exhibits, Sarantos, EX1014-EX1016, EX1018, and EX1028, as allegedly showing that “wrist-worn pulse oximetry sensors, such as that described in Sarantos, were well-known in the art, including in engineering and scientific papers published by well-respected and authoritative organizations such as IEEE.” Pet., 41-42. However, in my opinion, none of the references demonstrate that measuring oxygen saturation at the wrist was “well-known” or provide a reasonable expectation of success.

110. None of Apple’s six references, Sarantos, Pang, Li, Cai, Maattala, and Brady actually determined oxygen saturation at the wrist, let alone support the notion that such measurements were “well-known in the art.” Instead, those references at most reported detecting a PPG signal or a modulation ratio. But detecting a PPG signal or obtaining a modulation ratio is not a determination of oxygen saturation. As I understand, the Board previously held in IPR2022-01291 that “determine ... oxygen saturation” in the claims of the related ’745 Patent “requires actually calculating an oxygen saturation.” EX2096, 45-47. The ’159 Patent claims similarly require the determination of oxygen saturation, which a POSITA would have understood to mean actually calculating an oxygen saturation value. Thus, none of Apple’s references actually establishes that determining oxygen saturation at the wrist was “well-known” because none of those references actually disclose such oxygen saturation determinations.

111. Sarantos does not disclose determining oxygen saturation at the wrist, as explained above. *Supra* § VIII.D.1.

112. Pang (EX1014) does not present any oxygen saturation determinations from the wrist. The only data Pang presents are separate red and IR waveforms. EX1014, 1566. There is no indication that the two waveforms were time correlated, which would have impacted whether oxygen saturation could be determined from those waveforms. *See, e.g.*, [REDACTED]

[REDACTED]

And based on Figures 11 and 12, the red and IR waveforms do not appear to be time correlated. Further, Pang relies on simulated data in Figure 13 rather than actual data, showing that its authors were not able to determine oxygen saturation using Pang's design. EX1014, 1566 ("An oxygen saturation simulator is used and by doing some experiments, data relating the oxygen saturation and the R values are obtained."). Pang also does not demonstrate whether a POSITA would have had a reasonable expectation of success in modifying Iwamiya to measure oxygen saturation because Pang used a "special design of its concave shape [to] help[] the sensor module stay in the chosen location of the wrist." EX1014, 1567. Even if Pang's device were able to measure oxygen saturation, it would not indicate whether Iwamiya's design could be modified to measure oxygen saturation. Notably, Apple's engineers were aware of Pang. EX2104 [REDACTED] But Apple's engineers still were unable to achieve measuring oxygen saturation at the wrist at the relevant time. Thus, Pang does not show a reasonable expectation of success in the proposed combination.

113. Li (EX1015) is a paper coauthored by Dr. Steve Warren and Kejia Li. Dr. Warren was an Apple expert witness during the ITC Investigation. Li does not report any determinations of oxygen saturation from the wrist. Moreover, Li states, "At present, it is difficult to consistently obtain high quality PPG data from the wrist."

EX1015, 276. Li also presents three PPG signals apparently measured from the wrist.

*Id.* However, those three PPG signals appear to only have been from a single unknown wavelength, not the two wavelengths that would be needed to determine oxygen saturation. *Id.* A PPG signal from only one wavelength of light does not indicate the feasibility of determining oxygen saturation. Two consistent and correlated PPG signals from at least two different wavelengths are required in order to perform the complex algorithms for determining oxygen saturation. Moreover, the ability to obtain one PPG signal does not indicate the ability to obtain a PPG signal of similar quality at a different wavelength due to differences in how light of different wavelengths are absorbed by tissue. Indeed, Apple's own engineers still faced this issue in 2015. *See* EX2085, 8-9 [REDACTED]

[REDACTED];  
EX2083, 9 [REDACTED]. Moreover, Li could only measure PPG signals if the locations of the user's arteries was known beforehand. EX1015, 276. Furthermore, I understand that Apple's engineers were in possession of Kejia Li's Master thesis, which contains the same information as the Li publication. EX2101. Apple's engineers thus knew of Li and still were unsure whether oxygen saturation could be measured from the wrist. Thus, a POSITA would not have had a reasonable expectation of success in modifying Iwamiya to measure oxygen saturation from the wrist.

114. Cai (EX1016) also does not support a reasonable expectation of success. Cai does not present any determinations of oxygen saturation from the wrist. *See* EX1016. At best, Cai shows a “Change map of the value of R after breath holding for 10s and 25s.” EX1016, 1900. Cai does not explain what “R” is or how it is determined. However, R is *not* an oxygen saturation value. As shown in Cai’s Fig. 6, R *increases* when a user holds their breath, which is not what oxygen saturation would do. EX1016, 1900. Moreover, Apple’s engineers knew of the Cai reference since 2013. [REDACTED]

[REDACTED] EX2102, 78. Apple’s engineers were therefore aware of Cai and yet still were doubtful that oxygen saturation could be measured on the wrist.

115. Maattala (EX1018) similarly does not demonstrate a reasonable expectation of success. The authors expressly stated that they “concentrated on studying SNRs and signal amplitudes instead of finding out actual SpO2-readings.” EX1018, 1858. Thus, Maattala does not show any determinations of oxygen saturation. A good signal-to-noise ratio is, of course, required for determining oxygen saturation, but it is not enough. In fact, Maattala indicated that “[m]any problems still have to be overcome.” EX1018, 1860, Abstract. At best, Maattala identified a location on the wrist with a “Promising SNR.” EX1018, 1859-60. But that simply identified a location for more follow-up research. That does not

demonstrate a reasonable expectation of success for measuring oxygen saturation at the wrist, let alone that such measurements were well known or routine. I also understand that Apple’s engineers possessed a copy of the Maattala reference. EX2103. Yet even years later in 2015, Apple’s engineers still did not know if oxygen saturation could be measured on the wrist.

116. Brady (EX1028), also does not support a reasonable expectation of success for determining oxygen saturation at the wrist. Brady contains some mentions of oxygen saturation but much of its disclosure is actually focused on calculating burned calories. *See* EX1028. Brady also is not an “engineering” or “scientific paper[]” as Apple characterized its references, but rather is a patent application. Moreover, Brady’s under-the-wrist sensor is applied to a completely different site than Sarantos, which is for the top of the wrist. *Compare* EX1021, Figs. 1-2, 5 *with* EX1005, Figs. 1-2. As a patent application, Brady does not demonstrate the existence of a device that determines oxygen saturation at the wrist before 2015. Notably, Brady was filed by Impact Sports Technologies. [REDACTED]

[REDACTED]

[REDACTED]

EX2086, 3-4, 7-10. But again, as Apple’s own engineer confirmed, there were no commercial devices that measured oxygen saturation at the wrist as of late 2014. EX2076, 962:25-963:9, 964:2-6.

117. Additionally, I am not aware of any follow-up research that the authors of Apple's references published presenting any successful oxygen saturation measurements at the wrist or that any device that measured oxygen saturation from the wrist was ever developed as a result of their research. If Apple's cited references actually demonstrated that determining oxygen saturation at the wrist were "routine," "well-known," and that its feasibility were "conclusively establish[ed]" as Apple argued (Pet., 45), then at least one group would have published or made a device that successfully determined oxygen saturation at the wrist. The lack of any follow up would have been meaningful to a POSITA and would have left a POSITA with the understanding that such measurements were not reasonably expected to succeed by 2015. Indeed, as explained above, Apple's engineers were generally aware of these references and the general state of the art as they were industry veterans with decades of experience and were actively researching in 2015 how to achieve pulse oximetry at the wrist. Indeed, Apple specifically hired engineers who were "world experts" in this field and who knew "which sensor fusion ideas are likely to work, and which ones have been tried and failed (and they know why the failed)." EX2089, 2. Yet as they concluded, "Conventional sensing methods do not result in waveforms that are consistent enough for SpO<sub>2</sub> measurements at the wrist." EX2085, 13.

118. Additionally, Apple's cited references do not demonstrate a reasonable expectation of success in modifying Iwamiya's sensor design to determine oxygen

saturation at the wrist. None of the cited references relate to a sensor design that is similar to Iwamiya's. For example, none of the references disclose a material that changes the shape of light, let alone Iwamiya's annular light guide, or the way in which Iwamiya directs scattered light towards a central detector. Thus, none of the references speak to whether a POSITA would have expected success in modifying Iwamiya's sensor design to determine oxygen saturation at the wrist.

**5. Industry Skepticism, Failure of Others, and Long-Felt-but-Unmet Need Support Patentability of Claims 8 and 17**

119. As discussed above, Claims 8 and 17 require the determination of oxygen saturation from the wrist. Multiple objective indicia of nonobviousness support the patentability of these claims, including industry skepticism for determining oxygen saturation at the wrist, the failure of others to do so, and a long-felt but unmet need for such a feature.

120. As mentioned above, Apple's engineers were researching the feasibility of determining oxygen saturation at the same time as the July 2015 priority date for the '159 Patent. Their testimony and documents discussed above indicate industry skepticism as to whether oxygen saturation could be measured from the wrist. For example, Dr. Mannheimer was hired specifically to [REDACTED] [REDACTED] EX2080, 173:9-173:13. Yet his reaction to that assignment was, "good luck with that" and "I don't know if it can be done." EX2077, 1012:12-25; EX2080, 174:2-174:6. Moreover, the fact that Apple

hired Mannheimer specifically to [REDACTED]

indicates that at the time, a POSITA would not have thought that such measurements were feasible. If measuring oxygen saturation at the wrist were actually obvious to a POSITA at the time, then Apple would not have needed to hire an industry veteran with decades of experience [REDACTED].

121. I understand that in the IPR2022-01291 final written decision, the Board limited the skepticism expressed by Apple’s engineers as “in the specific context of developing a future iteration of the Apple Watch to determine blood oxygen saturation” and not “whether they were skeptical of being able to measure oxygen saturation at the wrist *at all*.” EX2096, 105 (original emphasis). That was incorrect because Apple’s engineers’ testimony and documents related specifically to whether oxygen saturation could be measured from the wrist at all. As explained above, Dr. Mannheimer was not hired simply to add oxygen saturation measurements to the Apple Watch as if it were some conventional feature. Instead, Apple hired him specifically to [REDACTED]

[REDACTED] EX2080, 173:9-13. Mannheimer explained that his skepticism arose from the physiological problems associated with trying to measure oxygen saturation from the wrist:

[REDACTED]  
[REDACTED]  
[REDACTED]

[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]

EX2080, 174:7-174:18. Moreover, Mannheimer expressed that his “good luck with that reaction” was as he “thought of it in the past with other clients,” indicating that his reaction was not limited to just the Apple Watch. EX2080, 173:14-174:1. Thus, contrary to the Board’s decision, Mannheimer’s testimony was about whether he was skeptical of being able to measure oxygen saturation from the wrist at all.

122. Apple’s other engineers also explained that their difficulties in measuring oxygen saturation at the wrist was due to the physiology of the wrist, not problems in the context of the Apple Watch. Dr. Waydo explained that “[t]he wrist is one of the most difficult places on the body to do almost every physiological measurement.” EX2081, 166:4-16. Dr. Shui similarly explained that the “most challenging part” of his work was because the Apple Watch is worn on the wrist “and the wrist is well known for its lack of signal.” EX12082, 108:13-21.

Apple’s documentation also showed that the engineers’ skepticism was due to the physiology of the wrist, beyond the context of the Apple Watch. For example, the engineers’ July 2015 presentation included a slide identifying a [REDACTED]

[REDACTED] EX2085, 6. The two challenges listed were [REDACTED] *Id.* Those

challenges had to do with the physiology of the wrist rather than trying to fit a sensor into an Apple Watch. Apple's engineers also observed that "Conventional sensing methods do not result in waveforms that are consistent enough for SpO<sub>2</sub> measurements at the wrist" and that "Invention is required" to achieve pulse oximetry at the wrist. EX2085, 13. Apple's engineers were also evaluating [REDACTED] [REDACTED] not restricted to the form factor of an Apple Watch. EX2085, 7, 12.

123. Additionally, the evidence discussed above, including from Apple, Fitbit, and Withings, also demonstrates that others had tried and failed to achieve oxygen saturation determinations at the wrist. For example, Apple's own engineers tried and failed in 2015 to determine oxygen saturation from the wrist. EX2085, 7-13. Apple's engineers concluded that "Conventional sensing methods do not result in waveforms that are consistent enough for SpO<sub>2</sub> measurements from the wrist." EX2085, 13. Mannheimer also explained that in 2015, [REDACTED] [REDACTED] [REDACTED] EX2094, 28:3-29:19.

124. Fitbit (the assignee of Sarantos) also was unable to release a device that measured oxygen saturation from the wrist before July 2015. Instead, the first such Fitbit device was release in 2020. EX2091; EX2092. And even then, Fitbit was

relying on “long-term average” during “overnight measurements” in order to measure oxygen saturation from the wrist. EX2088, 4. And as discussed above, Withings also released a device in 2014 that was mounted on a wrist strap, yet it could not measure oxygen saturation from the wrist. EX2095, 3-5. Instead, the device required that a user remove it from the wrist strap and place it on a finger to measure oxygen saturation. *Id.* Thus, multiple companies tried and failed to achieve oxygen saturation measurements at the wrist.

125. Additionally, the references that Apple cited to support reasonable expectation of success (EX1005, EX1014-EX1016, EX1018, EX1028) demonstrate that there was a long-felt but unmet need in the industry for a device that could determine oxygen saturation at the wrist. In particular, Apple’s cited references show that there were multiple research groups trying to tackle the problem of determining oxygen saturation from the wrist, yet none of those papers presented any determinations of oxygen saturation from the wrist. Moreover, as Apple’s engineer explained, a device that could measure oxygen saturation from the wrist was still “unprecedented” at the time of the ’159 Patent. EX2076, 962:25-963:9, 964:2-6.

126. Accordingly, industry skepticism, failure of others, and long-felt but unmet need further confirm that Claims 8 and 17 would not have been obvious to a POSITA as of July 2015.

**E. Apple’s Combination Does Not Disclose an Opening in the Dark-Colored Coating with a Different Width and Length (Claim 12)**

127. Claim 12 recites, “The physiological monitoring device of claim 1, wherein the opening defined in the dark-colored coating comprises a width and a length, and wherein the width is larger than the length.” Apple’s Petition, however, does not explain how the Iwamiya-Sarantos combination discloses the limitation.

128. In the Petition, Apple identified Iwamiya’s optical filter 17 as the “opening defined in the dark-colored coating.” Pet., 31-32. However, the Petition does not explain how Iwamiya’s optical filter 17 comprises a different width and length. Instead, the Petition switches to arguing that the window regions 2226 in *Sarantos*’s Fig. 22 have a different width and length because they are co-extensive with the high-aspect-ratio (HAR) photodetector elements in Sarantos. Pet., 47-49. Apple then concluded that “the window regions defined in the dark-colored coating (the window in Iwamiya’s light shielding frame 18 in the predictable combination) each include a width and a length corresponding to the width and length of their respective HAR photodiodes, and thus have a width that is larger than the length, in at least some configurations.” Pet., 49.

129. Apple’s argument does not make sense because it does not follow the proposed Iwamiya-Sarantos combination. Apple referenced “the window regions defined in the dark-colored coating” with respect to Iwamiya. But Apple relied on the *single* optical filter 17 in Iwamiya as the supposed “opening.” There are not

multiple “window regions” in the Iwamiya-Sarantos combination. Apple’s argument also relies on window regions 2226 being co-extensive with Sarantos’s HAR photodetectors. However, Apple’s Iwamiya-Sarantos combination does not involve Sarantos’s HAR photodetectors. Apple never presented an obviousness theory that combined Iwamiya with Sarantos’s HAR photodetectors, much less argue that there would be multiple window regions in Iwamiya each corresponding to a HAR photodetector.

130. Additionally, Sarantos’s HAR photodetectors would not be combined with Iwamiya because Sarantos designed the HAR photodetectors to better capture scattered light from a centrally located emitter. EX1005, Figs. 4-6, 8:39-11:3. Iwamiya has the opposite configuration where light is gathered and focused towards a central detector. EX1005, Figs. 4-6, 8:39-11:3. Sarantos’s HAR photodetectors would not provide a benefit in that situation.

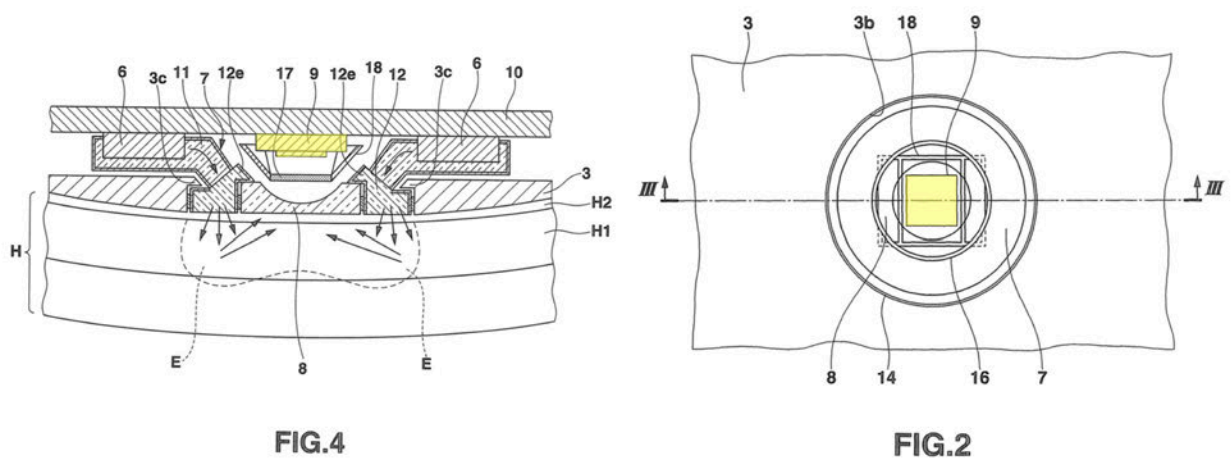
131. Accordingly, Apple’s argument does not explain how the Iwamiya-Sarantos combination discloses the limitation of Claim 12.

**F. Iwamiya Does Not Disclose a Circular Array of Detectors (Independent Claim 14 and Dependent Claims 5 and 25)**

132. Claim 14 recites a “plurality of detectors . . . arranged in an array having a spatial configuration corresponding to a shape of the portion of the tissue measurement site bounded by the circular shaped light block.” Apple’s argument regarding this limitation cross-referenced its argument for Claim 5. *See* Pet., 62

(citing [5]). Thus, I will address Apple's arguments set forth there. Apple's arguments regarding this limitation are similar to the arguments it presented in IPR2022-01291 with respect to a similar limitation in Claim 15 of the related '745 Patent. I understand that the Board previously found that Iwamiya discloses this limitation and that the Board's Institution Decision in this IPR adopted the prior finding. Inst., 35-39. However, I respectfully disagree with the Board's prior conclusion for the reasons set forth below.

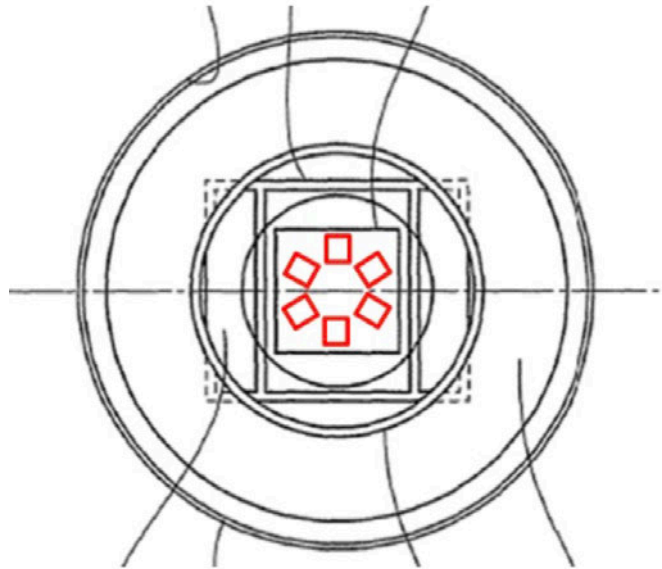
133. Apple relied upon the embodiment in Iwamiya illustrated in Figures 1-4. See Pet., 30-33; EX1004, 4:5-16 (explaining Figures 2-4 illustrate the same embodiment). However, Iwamiya does not depict a plurality of photodetectors in any of its figures of the first embodiment. Instead, Iwamiya's figures illustrate only a single photodetector (labeled as light receiving unit 9), as shown and highlighted yellow below:



EX1004, Figs. 4, 2 (annotated).

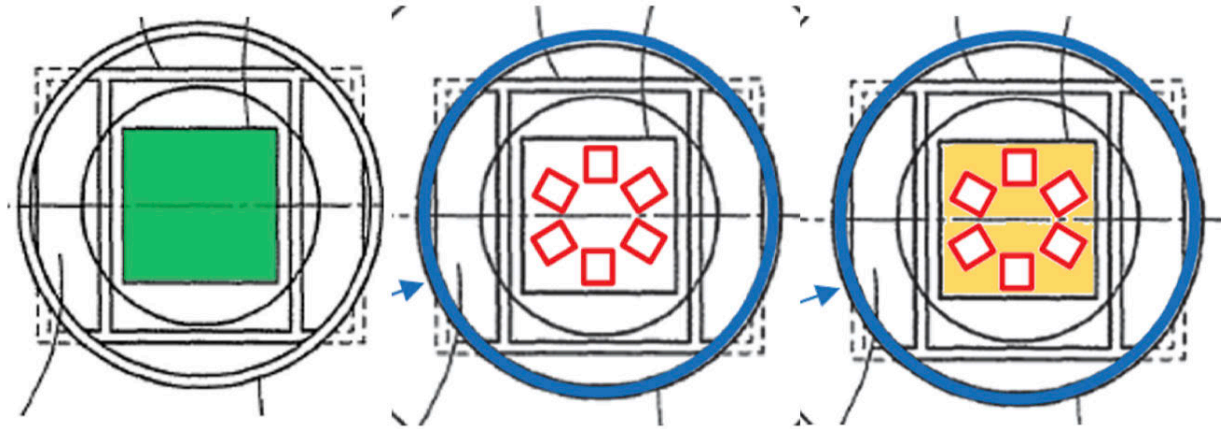
134. Apple relies on a description in Iwamiya of an alternative embodiment where “plural light receiving units 9 may be two-dimensionally disposed in the places positioned at the side opposite to the skin H in the scattered light taking unit 8” and “the plural light receiving units 9 are preferably disposed on the same circumference centered on an optical axis of the scattered light taking unit 8.” Pet., 31 (citing EX1004, 14:36-41). However, as discussed above, Iwamiya does not illustrate that alternate embodiment or how the photodetectors would be arranged. Thus, the text of Iwamiya does not demonstrate that there are a plurality of photodetectors arranged “in an array having a spatial configuration corresponding to a shape of the portion of the tissue measurement site bounded by the circular shaped light block” as required.

135. Apple and its expert argue instead that a POSITA would have understood from Iwamiya’s disclosure and would have found it obvious to arrange significantly smaller photodetectors in the following arrangement:

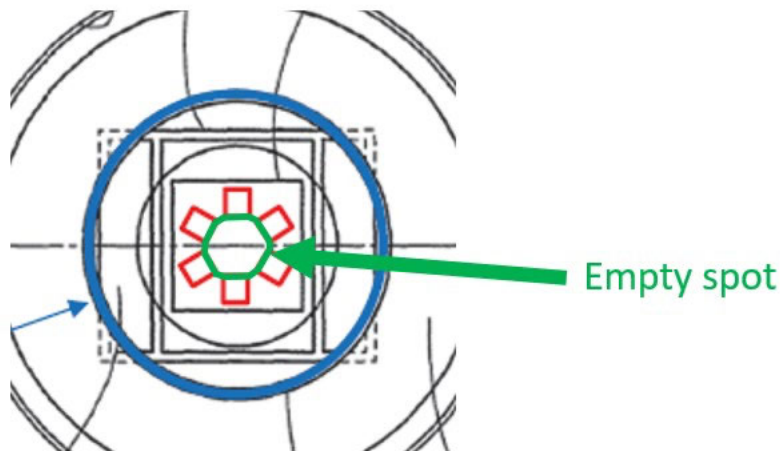


Pet., 33 (Apple’s annotation of EX1004, Fig. 2, cropped).

136. Apple argues that a POSITA would have been motivated to make this arrangement to “increas[e] detection area and light sensitivity.” Pet., 34. But that is clearly incorrect. Apple’s proposed arrangement, which removes the original larger photodetector and replaces it with six significantly smaller photodetectors would only *decrease* detection area and light sensitivity. For example, as shown in the left image below, the original photodetector 9 is highlighted in green. Apple’s proposed modification of Iwamiya to include six photodetectors (outlined red) is shown in the center image. The right image shows in yellow how much of the original photodetector coverage is lost by Apple’s proposal.



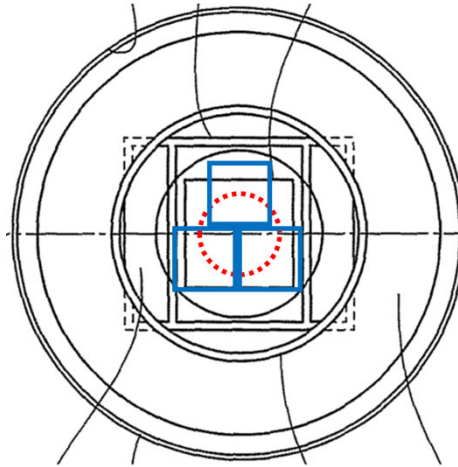
Under Apple's proposed modification, the photodetector coverage is reduced by *more than 50%*. Apple has no explanation how reducing photodetector coverage by more than 50% is somehow an increase in detection area and light sensitivity. Moreover, Apple's proposal creates a large empty spot in the center without photodetector coverage.



137. In Iwamiya's sensor design, where light emitted on the periphery is directed towards a central light detector, it makes no sense to create a large empty spot by removing photodetector coverage, as Apple proposes. A POSITA would not

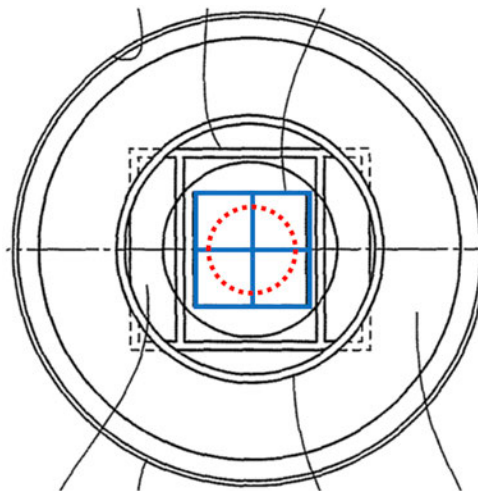
have understood Iwamiya to propose such a strange and detrimental design. Such a design would be severely detrimental to sensor performance by reducing photodetector coverage. Indeed, the Board previously found in IPR2022-01291 that Iwamiya uses a “scattered light taking unit 8, which is a transparent lens to focus the light on light receiving unit 9.” EX2096, 17; EX1004, 6:14-21, 7:50-8:13, 10:62-11:3, 12:55-67. It makes no sense for Iwamiya’s sensor design to focus light using the scattered light taking unit 8 to a spot where there is no photodetector coverage. Accordingly, a POSITA would not have understood Iwamiya to have disclosed the claimed array of detectors as Apple argues.

138. Instead, a POSITA would have interpreted Iwamiya’s reference to light receiving units “disposed on the same circumference centered on an optical axis of the scattered light taking unit 8” to refer to the photodetectors’ relative location (i.e., that a circle can be drawn through the center of each of the photodetectors), not a circular array of detectors. For example, three photodetectors can be placed in a triangular array and those photodetectors would be “disposed on the same circumference,” as shown below:



EX1004, Fig. 2 (annotated). But this arrangement would not meet the claim limitation because it is a triangular array and three detectors are not sufficient to form a circular array.

139. Similarly, four photodetectors can be placed in a square-shaped array that covers the same photodetector area as the original photodetector 9, as illustrated below:



EX1004, Fig. 2 (annotated). But this arrangement also does not satisfy the claim limitation because it is a square-shaped array, just as the original photodetector 9 is

in a square shape. Notably, a POSITA would have understood that more than four photodetectors would not be able to be “disposed on the same circumference” without running into the problem of leaving an empty spot in the center without photodetector coverage. For example, five photodetectors cannot be placed with their centers all disposed on the same circumference without leaving an empty spot in the center of the array. That problem would exist for configurations using more photodetectors. Thus, a POSITA would not have understood Iwamiya’s description of an alternate embodiment to disclose an array of photodetectors in a circular array.

140. I note that the Board in IPR2022-01291 emphasized the “generally circular configuration of Iwamiya’s biological information detecting apparatus” to find that Iwamiya disposed photodetectors in a circular array. EX2096, 124. But that observation was not relevant because it is not true for Iwamiya’s photodetector. Instead, Iwamiya’s Figure 2 illustrated a square photodetector, not a circular one. EX1004, Fig. 2. Iwamiya positioned its photodetector at the center of its device. *Id.* Accordingly, a circular array of detectors would substantially decrease the signal strength by failing to detect the light that is focused by the scattered light taking unit 8 to the center of the device. Given all of Iwamiya’s disclosures of weak signal problems, a POSITA would not have understood Iwamiya to disclose such a circular array. Accordingly, Claim 14 would not have been obvious to a POSITA. Similarly,

Apple failed to show Claims 5 and 25 would have been obvious for the same reasons as Claim 14.

**G. Apple Fails to Address the Limitation of Claim 24**

141. Claim 24 recites “The system of claim 19, wherein the second shape comprises a width and a length, and wherein the width is different from the length.” The Petition’s argument regarding Claim 24 was a cross-reference to Claim 12. *See* Pet., 74. But Claim 12 does not recite a similar limitation to Claim 24. Claim 24’s reference to “the second shape” refers to the “second shape by which the light emitted from one or more of the plurality of emitters is projected towards the tissue measurement site” in Claim 19. In contrast, Claim 12 recites “The physiological monitoring device of claim 1, wherein the opening defined in the dark-colored coating comprises a width and a length, and wherein the width is larger than the length.” Thus, Claim 12 concerned the opening in the dark-colored coating, not the “second shape” of light emitted towards the tissue measurement site. Thus, in my opinion, Apple fails to show that Claim 24 would have been obvious.

**IX. CONCLUSION**

142. As set forth in this Declaration, it is my opinion that Apple has failed to demonstrate that any of the challenged claims of the ’159 Patent would have been obvious to a POSITA.