

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,

Petitioner,

v.

MASIMO CORPORATION,

Patent Owner.

IPR2024-00244

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:

11/3/24



Vijay K. Madiseti, Ph.D.

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I, Vijay K. Madiseti, declare as follows:

1. My name is Vijay K. Madiseti. 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 IPR2024-00244, 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. Madiseti, “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. Madiseti, "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:

- Madiseti, 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 accompanying each petition, 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:

Exhibit No.	Description
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), https://mathworld.wolfram.com/Annulus.html
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

Exhibit No.	Description
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 (https://www.washingtonpost.com/technology/2020/09/23/apple-watch-oximeter/)
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 (https://www.forbes.com/sites/andrewwilliams/2020/09/09/fitbit-update-lets-you-quickly-check-your-blood-oxygen-saturation/?sh=5d6ecb55e76a)
2092	“Track Your SpO2 to Uncover Changes in Your Wellbeing,” Fitbit, Sept. 7, 2020 (https://blog.fitbit.com/track-your-spo2/)
2093	CONFIDENTIAL – ITC Final Initial Determination (Public version filed at Exhibit 2043)

Exhibit No.	Description
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), https://www.cnet.com/reviews/withings-pulse-o2-review/ (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. (https://support.apple.com/en-us/120358)
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.

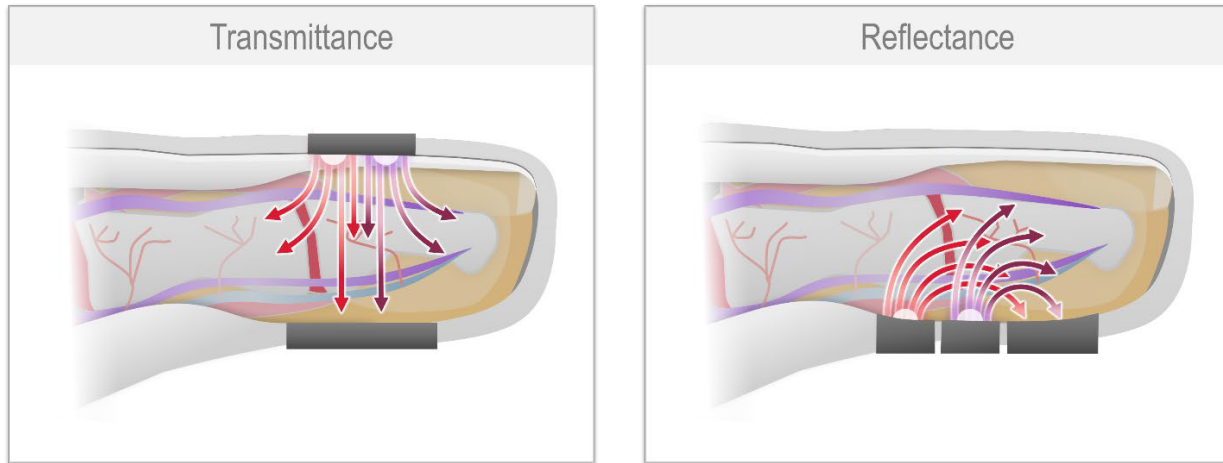
IV. BACKGROUND OF THE TECHNOLOGY

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 (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.” The claims also recite a “light block configured to prevent at least a portion of the light” from the emitter from reaching 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 SpO₂ continuously at the wrist. EX2008, 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. Sarantos (EX1005)**

45. 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 photoplethysmography techniques for measuring heart rate.” *Id.* at 18:35–44 (emphasis added). 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 18:35–41.

2. Shie (EX1007)

46. U.S. Patent No. 6,483,976 to Shie et al. is titled “OPTICAL ELEMENT HAVING AN INTEGRAL SURFACE DIFFUSER” and was originally assigned to Physical Optics Corporation. EX1007 at Title. Shie relates “generally to the field of optics, and more particularly to various optical elements incorporating an integral surface diffuser as a portion of the optical element.” *Id.* at Background of the Invention. Across 22 figures, Shie describes over a dozen different types of optical elements. *Id.* at FIGS. 1a-11. Shie is not related to health monitoring technologies and does not teach or suggest any application of its optical elements in any physiological sensor. *See generally id.* Shie makes no mention of a pulse oximeter. *See generally id.*

3. Brady, Han, and Utter (EX1021, EX1008, EX1006)

47. Apple also relies upon three additional references, Brady (EX1021), 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 alone or 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., 21-23. 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., 22 (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. “change the first shape into a second shape”

50. Independent Claim 1 of the '159 Patent recites a “material configured to change the first shape into a second shape by which the light emitted from one or more of the plurality of emitters is projected towards a surface of the tissue measurement site.” Independent Claim 19 contains an almost identical limitation where “a surface of” is omitted. I understand that the parties agreed in the Delaware Litigation that the second shape must be a “shape different from the first shape (not just a change in size).” EX2038, 5. And I further understand that the Board has likewise agreed that “this claim limitation in claims 1 and 19 refers to different shapes rather than merely different sizes of the same shape.” Inst., 24.¹

VII. SUMMARY OF OPINIONS

51. It is my conclusion, from a technical point of view, that Claims 1–5, 7–14, and 16–25 of the '159 Patent would not have been obvious to a POSITA based on the grounds asserted by Apple in the '244 Petition. In particular, it is my opinion that:

¹ I also provide an opinion regarding the construction of “determine...oxygen saturation” in Section VIII.C.3 below.

- (Ground 1A) Claims 1–5, 7–9 and 12–13 would not have been obvious to a POSITA based on Sarantos;
- (Ground 1B) Claim 1–5, 7–14, 16–18 would not have been obvious to a POSITA based on Sarantos and Shie;
- (Ground 1C) Claim 2 would not have obvious to a POSITA based on Sarantos and Brady;
- (Ground 1D) Claim 3 would not have obvious to a POSITA based on Sarantos, Brady, and Han;
- (Ground 1E) Claim 2 would not have obvious to a POSITA based on Sarantos, Shie and Brady;
- (Ground 1F) Claim 3 would not have obvious to a POSITA based on Sarantos, Shie, Brady, and Han;
- (Ground 1G) Claims 14 and 16–25 would not have obvious to a POSITA based on Sarantos and Utter;
- (Ground 1H) Claims 14 and 16–25 would not have obvious to a POSITA based on Sarantos, Shie and Utter.

VIII. ANALYSIS

A. Grounds 1A, 1C, 1D, and 1G Fail to Show Obviousness

1. Apple Fails to Demonstrate That Sarantos Discloses Changing a First Shape of Light Into a Different Second Shape (Claims 1 and 19)

52. Independent Claims 1 and 19 both require a “material configured to change the first shape into a second shape.” Apple argues that Sarantos by itself discloses this limitation. Inst., 29 (citing Pet., 9-10, EX1003, ¶35 (“light shining through a translucent or transparent material as described in the specific arrangement of Sarantos would *necessarily* change in shape due to the refractive properties of translucent and transparent materials”)). However, Apple previously admitted that Sarantos alone does not disclose a change in the shape of light and a POSITA would understand that light transmitting through a flat transparent or translucent window like in Sarantos does not change shape.

a) Apple Conceded that Sarantos Does Not Disclose a Change in the Shape of Light

53. I understand that Apple expressly admitted that Sarantos *does not* disclose a material that changes the shape of light. Specifically, during oral argument in IPR2022-01291 and IPR2022-01465, Apple’s attorney pointed to Sarantos’s Figure 22 (the same figure Apple relied on in the present Petition) and stated:

Sarantos doesn’t describe the material as configured to change the first shape of light entering the material from the light source 2208 to a different second shape of light exiting the material towards the

tissue. And so, turning to slide 51, we see that Shie describes such material.

EX2099, 18:14-20. Apple thus has already conceded that Sarantos does not disclose a material configured to change the shape of light and relied on a different reference, Shie, to allegedly provide that disclosure. Moreover, I agree with Apple's statement that Sarantos does not describe a material configured to change the first shape of light into a second shape. There is no disclosure in Sarantos that would suggest to a POSITA that the window in Figure 22 of Sarantos is configured to change the shape of light from a first shape into a second shape. *See* EX1005.

b) Sarantos's Window Does Not Disclose the Claimed Change in Shape (Claims 1 and 19)

54. The Board's Institution Decision recognized that Apple's argument regarding Sarantos was not a "traditional obviousness modification and rationale" because Apple did not argue that it "would have been obvious to modify Sarantos to include such a feature." Inst., 29. Instead, the Board understood Apple's argument as "a POSITA, when interpreting Sarantos, would understand that its translucent or transparent window material would *necessarily* change the shape of the light." Inst., 29; *see* Pet., 9-10 ("light shining through translucent or transparent material would change in shape due to the refractive properties of translucent and transparent materials"), EX1003, ¶35 ("light shining through a translucent or transparent material as described in the specific arrangement of Sarantos would necessarily change in

shape due to the refractive properties of translucent and transparent materials”). However, Apple’s argument fails because transparent or translucent materials do not necessarily change the shape of light passing through them due to refraction.

55. The prosecution history of parent application 16/532,065 confirms that there are refractive materials that do not change the shape of the light. During prosecution of the ’065 parent application, Masimo conducted an interview with the Examiner. EX2056 at 162. The interview summary stated:

“Agreement was reached that Applicant’s proposed claim amendments, which reflect a change in shape of emitted light beyond a change in size, defined over the Examiner’s citation of judicial notice of emitted light passing through a lens.”

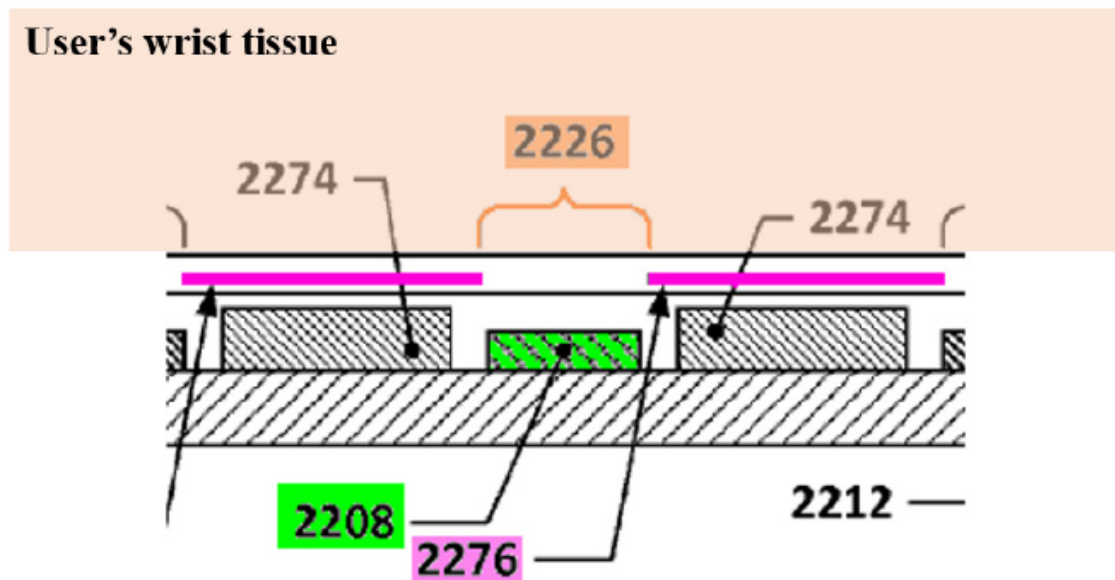
Id.

56. A POSITA would have understood that a lens magnifies images through optical refraction. A lens is an example of a translucent or transparent material. However, a lens that simply changes the size of the shape of light, without more, does not change the shape of light. Therefore, Apple’s claim that “light shining through translucent or transparent material would change in shape due to the refractive properties of translucent and transparent materials” is incorrect because the prosecution history already identified an example of a translucent or transparent material that does not change the shape of light due to refraction.

57. Additionally, neither Apple nor its expert provided any evidence that Sarantos’s window is configured to change the shape of light into a different shape

than the first shape incident on Sarantos's window. The Institution Decision appeared to indicate that Anthony's speculation was sufficient evidence to institute the IPR. Inst., 28. But Anthony did not address or explain whether the shape of light would be *different* than a change in size. EX1003, ¶35. Anthony's testimony is not sufficient to demonstrate a second shape that is a "shape different from the first shape (not just a change in size)."

58. Additionally, a POSITA would not understand and would not expect that Sarantos's window would change the shape of light. The Petition relied on window region 2226 in Sarantos's Figure 22 and asserted that "light shining through translucent or transparent material would change in shape due to the refractive properties of translucent and transparent materials." Pet., 9-10. Apple's annotations to Sarantos's Figure 22 are reproduced below:



Pet., 9 (Apple's annotations of Sarantos' Figure 22).

59. However, a POSITA would not understand Sarantos's window 2226 to change the shape of light, particularly because a change in shape cannot be merely a change in size. As shown above, Sarantos's window is depicted as flat in Figure 22. And a POSITA would know that a flat window does not result in any change in the shape of light. Nearly all windows on buildings are flat translucent or transparent materials, yet the shape of light does not change when it passes through a window.

60. Apple incorrectly relies on refraction to allegedly show change in shape of light. Pet., 9-10. However, refraction through a flat translucent or transparent material does not change the shape of light. The law of refraction, or Snell's law, describes how light bends at the interface between two media with different indices of refraction. *See* EX2097, 60-63. A POSITA would have understood that lenses can magnify the shape of light via refraction. But changing the size of a shape is not claimed. EX2038, 5. Further, a POSITA would have known that when light transmits through a flat material, refraction would cause the light to emerge parallel to how it entered the material initially. For example, the optics textbook, *Principles of Physical Optics*, demonstrates with a mathematical proof that light refracting through a flat material would emerge parallel to how it entered the material. EX2097, 62-63, Fig. 3.3 (reproduced below).

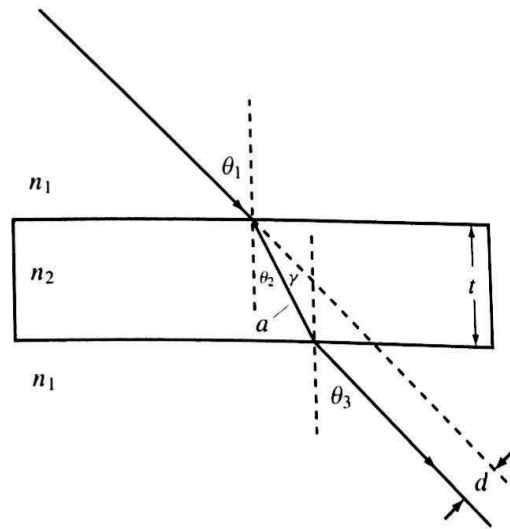


Figure 3.3. Light rays refracting through a slab of material with parallel sides.

EX2097, 62-63. Thus, light refracting through a flat translucent or transparent material would at most have a slightly different size, but not a different shape. I note that Dr. Anthony’s declaration also argued that Sarantos’s in-mold label would define the shape of light. EX1003, ¶35. But (1) that argument does not appear in the Petition, and (2) Dr. Anthony provided no evidence of such a change beyond him saying so. Dr. Anthony did not compare the shapes of light before and after the in-mold label.

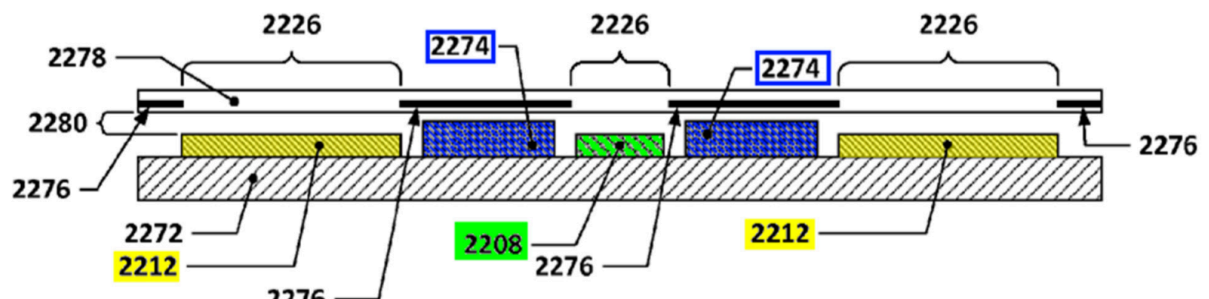
61. Therefore, it is my opinion that Apple has not demonstrated that Claim 1 or 19 would have been obvious to a POSITA based on Sarantos alone, because Sarantos does not disclose or render obvious a “material configured to change the first shape into a second shape” as required by Claims 1 and 19.

62. Accordingly, Apple’s Grounds 1A, 1C, 1D, and 1G fail to demonstrate obviousness over Sarantos for Claims 1, 19, and their challenged dependent claims.

2. Sarantos Does Not Disclose the Claimed Array of Detectors (Claim 5)

63. Dependent Claim 5 recites a “plurality of detectors are arranged in an array having a spatial configuration corresponding to a shape of a portion of the tissue measurement site bounded by the light block.” In my opinion, Apple has not demonstrated that this limitation has been disclosed by Sarantos or that it would have been obvious over Sarantos.

64. Apple relied on Sarantos’s Figure 22 and pointed to the walls 2274 as the “light block.” Pet., 18-19. Apple’s annotations to Figure 22 are reproduced below, with the walls 2274 highlighted in blue:



Pet., 19 (Apple’s annotations to EX1005, Fig. 22).

65. However, Figure 22 depicts a cross section of Sarantos’s sensor taken from the *side*, which fails to show the shape of the walls 2274 when viewed from the *top*. A POSITA would not be able to identify the “shape of a portion of the tissue measurement site bounded by the light block” from Sarantos’s Figure 22. For

example, the cross-section of the walls 2274 can show several different possibilities of shapes including two separate walls, a square wall, a rectangular wall, a circular wall, or many different other shapes. The specific shape of the alleged light block is not disclosed by the cross section shown in Figure 22. Therefore, Sarantos's Figure 22 does not represent the "shape of a portion of the tissue measurement site bounded by the light block" as required by Claim 5.

66. Further, Apple pointed to a different embodiment, Sarantos's Figure 25, with respect to the shape of the light block. Pet., 19. However, Figure 25 does not show any light block at all, let alone identify the shape of that light block. EX1005, Fig. 25, 19:33-52. Figure 25 therefore does not inform a POSITA as to what shape the light block would be.

67. Apple also argued that implementing the wall 2274 in Figure 25 would result in the light block being arranged in a circular configuration or that a circular light block would have been obvious. Pet., 20-21. However, a POSITA would have understood that many shapes of light blocks would have worked with Figure 25's annular detector, including a square light block. For example, a square-shaped light block would have worked in Figure 25, as shown below (red).

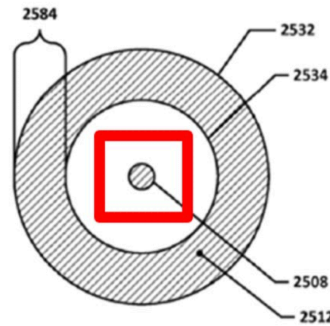
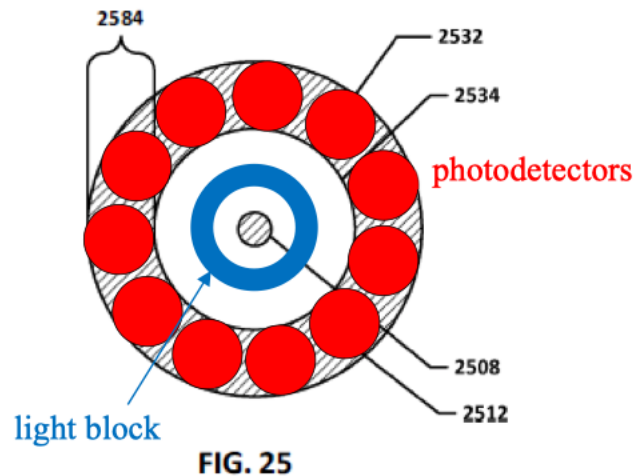


FIG. 25

Indeed, Apple also argued about using a circular light block with a triangular array of detectors. Pet., 22. Apple’s expert even admitted that “differently shaped light blocks (e.g., rectangular, triangular, etc.) could be used with the circular configuration of the photodetectors.” EX1003, ¶65. Thus, a POSITA would have understood that the shape of the light block is independent of the arrangement of the photodetectors.

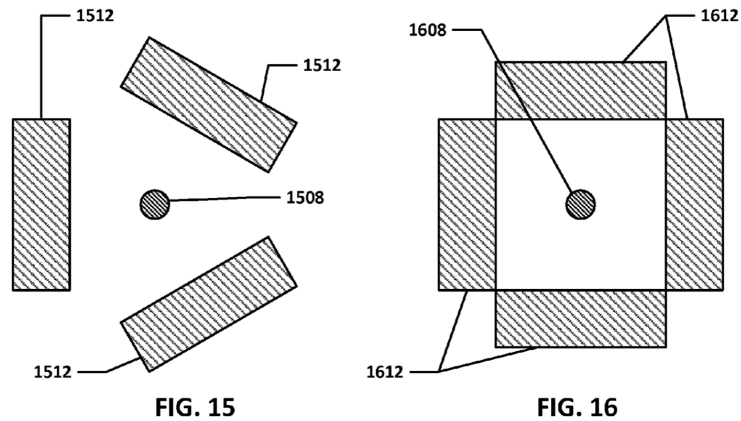
68. Moreover, Apple’s argument made multiple logical leaps that a POSITA would not have made when reading Sarantos. Apple began with Sarantos’s Figure 22, which disclosed two detectors but did not disclose the shape of the tissue measurement site bounded by a supposed light block. To create a light block with a specific shape, Apple turned to a different embodiment in Figure 25 which does not disclose any light block at all. But because Figure 25’s single photodetector cannot satisfy the requirement for a “plurality” of detectors, Apple modified Figure 25 to break up the single annular detector into eleven smaller detectors, shown below.



Pet., 21 (Apple's annotations to EX1005, Fig. 25).

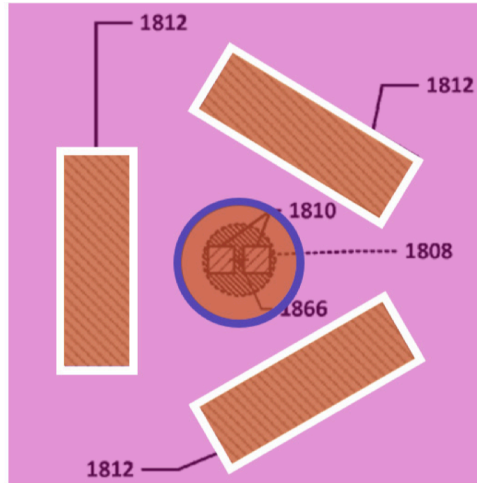
69. Apple failed to explain why a POSITA would have been motivated to perform this several-step modification that alternates between two, one, and eleven detectors and attempts to reconstruct a specific shape for the light block and detector arrangement. Only hindsight could have provided the motivation.

70. Further, Apple presented a separate argument based on Sarantos's Figures 15 and 16 instead of Figure 25. Pet., 21-23. Figures 15 and 16 are reproduced below, showing a triangular and square arrangement of photodetectors. EX1005, Figs. 15, 16.



71. Apple presented a single sentence argument that “FIGs. 15-16 provide this claim, disclosing multiple photodetector elements (three and four respectively) arranged in an array corresponding to a circular shape about their respective light sources.” Pet., 21-22. But Apple’s conclusory statement failed to identify the shape of the light blocks in Figure 15-16. Those figures do not show any light block. Thus, it is impossible to determine whether the photodetectors in Figures 15 and 16 are in an array that corresponds to the shape of the tissue measurement site bounded by a light block.

72. Finally, Apple argued that a POSITA would have implemented a circular light block with the three photodetectors in Sarantos’s Figure 18, as shown below:



Pet., 22 (Apple’s annotations to EX1005, Fig. 18). But this configuration does not meet the claim limitation. Masimo explained during the prosecution of a related application that three photodetectors cannot correspond to a circular shape. EX2057, 322. I further understand that the Board has repeatedly affirmed that Masimo’s statements during prosecution exclude arrangements of two or three photodetectors when the light block has a circular shape, including in a parallel IPR concerning the ’159 Patent. *See* EX2035, 109-112; *Apple Inc. v. Masimo Corp.*, IPR2024-00243, Paper 11 at 17-19 (PTAB July 9, 2024). Accordingly, in my opinion, Apple has not shown that Claim 5 would have been obvious.

3. Sarantos Does Not Disclose a Diffuser (Claim 14)

73. Claim 14 requires “a diffuser configured to be positioned between the plurality of optical sources and a tissue measurement site on the wrist of the user when physiological monitoring device is in use.” I understand that Apple refers to this as limitation 14.2. However, Apple did not argue that Sarantos discloses such a

diffuser. Pet., 57-58. Instead, Apple argued, “Sarantos-Utter provides, or at least renders obvious, elements [14.0]-[14.6] for the reasons discussed in Ground 1B.” *Id.* I disagree with that argument for the following reasons.

74. First, Ground 1B is directed to a combination of Sarantos with Shie, not Sarantos alone. In Ground 1B, Apple relied on Shie, not Sarantos, as disclosing a “diffuser.” See Pet., 40-41 (arguing Limitation [14.2] is met by a diffuser from Shie combined with Sarantos); Anthony’s declaration similarly refers to his Ground 1B argument. See EX1003, ¶171 (referencing “element [14.2] in Ground 1B, above”).

75. Additionally, even if Apple and Anthony both meant to refer to Ground 1A, Ground 1A did not address Claim 14 and did not identify any diffuser in Sarantos. I understand that the Board acknowledged in the Institution Decision, the “analysis addressing Ground 1A may not adequately address limitation 14.2.” Inst., 33.

76. Finally, Apple conceded that Sarantos **does not** disclose a diffuser. I understand that in IPR2020-01722, which challenged related U.S. Patent No. 10,470,695 based on the same Sarantos reference, Apple admitted: “Neither Sarantos nor Mendelson-1991 disclose a diffuser.” EX2105, 63; *see also* EX1011, 17-18 (“[Apple] expresses that all features of claims 6, 14, and 21, with the exception of a diffuser, are found in Sarantos and Mendelson-1991.”). I agree that Sarantos does not disclose a diffuser. See EX1005.

77. Apple therefore failed to demonstrate that Claim 14 and dependent Claims 16, 17, and 18 would have been obvious over the alleged prior art references.

4. Sarantos Does Not Disclose a “Light Block Having a Circular Shape” (Claim 14)

78. Claim 14 requires “a light block having a circular shape” and a “plurality of detectors are arranged in an array having a spatial configuration corresponding to a circular shaped light block.” I understand that Apple’s argument in Grounds 1G and 1H for these limitations cross-reference its Ground 1B argument (which, as explained above, is the wrong ground), which in turn cross-references its Claim 5 argument. Pet., 58, 68, 41. For the reasons already discussed above with respect to Claim 5, Apple failed to demonstrate that Sarantos discloses a light block having a circular shape and the claimed arrangement of detectors.

5. Apple’s Argument Did Not Address Claim 24

79. Apple’s Petition fails to adequately address Claim 24. Apple argued in both Grounds 1G and 1H that Claim 24 would have been obvious based on a cross-reference to its Claim 12 argument. Pet., 68, 70. However, Claims 12 and 24 recite different limitations. Claim 12 concerns the “opening defined in the dark-colored coating” having a different width and length whereas Claim 24 concerns the “second shape” of light having a different width and length. Apple therefore fails to demonstrate Claim 24 would have been obvious.

B. Grounds 1B, 1E, 1F, and 1H: Sarantos in view of Shie; Shie and Brady; Shie, Brady, and Han; and Shie and Utter

80. In Grounds 1B, 1E, 1F, and 1H, Apple argues that Claims 1–5, 7–14, and 16–25 would have been obvious to a POSITA over the combination of Sarantos and Shie or the combination of Sarantos and Shie further combined with one or more references (i.e., Brady, Han, Utter). Petition, 1–2, 30–44, 50, 68–70. Apple has not shown that any of the challenged claims would have been obvious.

1. Apple Fails to Demonstrate a Motivation to Combine Sarantos and Shie

81. For all the challenged claims, Apple has failed to demonstrate that a POSITA would have been motivated to combine Sarantos and Shie. I understand that the Board previously found that Apple failed to demonstrate a motivation to combine Sarantos and Shie in IPR2022-01465. *See* IPR2022-01465, Final Written Decision at 143–144. Based on my review, Apple’s Petition presents substantially the same arguments that it presented in IPR2022-01465, and therefore also fails to demonstrate a motivation to combine for the same reasons.

82. First, a motivation to combine is necessary because Sarantos and Shie have nothing to do with each other. Sarantos describes improvements to a heart rate sensor by replacing conventional square photodetector elements with high-aspect-ratio (HAR) photodetector elements to improve light collection capabilities. *See generally* EX1005. Sarantos does not discuss shaping the light by configuring a

material between the LED and the user's skin. *Id.* In contrast, Shie has no relation to physiological sensors at all. *See generally* EX1007. Shie is not related to health monitoring technologies and does not teach or suggest any application of its optical elements in any physiological sensor, pulse oximeter or heart rate sensor. *Id.* Instead, it discusses “automotive applications” such as “interior dome lights, simple trailer lights” and “vehicle taillamp construction.” *Id.* at 6:8–11. Nor does Shie solve any problem related to photoplethysmography that would have motivated a POSITA to look towards combining Sarantos with Shie. There is no reason why a POSITA would have looked to Shie at all.

83. The Petition provides the same three rationales for why a POSITA would combine Sarantos and Shie that the Board previously rejected. Pet., 32–35; *See* IPR2022-01465, Final Written Decision at 142–147. First, Apple argues that a POSITA would have been motivated to implement Sarantos' window region 2226 using a light shape changing material as taught by Shie to “more precisely direct the light emitted toward the tissue so as to increase power efficiency by shining light closer to photodiodes, as light not incident on the photo diodes represents wasted power.” *Id.* at 32–33. Second, Apple explains that it is to “direct[] light towards a larger area to decrease irregular readings caused by moles or other aberrations on the skin.” *Id.* at 33–34. Third, Apple explains that it is “to obscure appearance of the light source from a user.” *Id.* at 34–35.

84. However, as noted above, Apple does not explain *which* optical element from Shie would be combined with Sarantos or *how* such an optical element could achieve the three alleged motivations. *See* Petition at 32–35. Apple referred vaguely to “a light shape changing material (as taught by Shie),” without explaining what that material is. *Id.* at 32–33. Instead, Apple left the combination vague by pointing broadly to Shie’s Figures 1a-8b and arguing that “Shei [sic] provides numerous examples of various lens shapes and structures that provide the disclosed light shaping functionality.” *Id.* at 32. As the Board explained in IPR2022-01465, “[I]t is impossible to evaluate the merits of these assertions without first identifying a particular lens structure for use in Sarantos’s Figure 22 sensor. We reject the notion that *any* light shape changing material would have achieved these three benefits in Sarantos’s Figure 22 sensor.” IPR2022-01465, Final Written Decision at 143–144. I agree with the Board’s conclusion on this point.

85. Dr. Anthony’s declaration also does not demonstrate a motivation to combine. EX1003, ¶¶ 99–102. Like the Petition, Dr. Anthony also failed to identify a specific optical element of Shie that yields all the purported benefits. *See generally* EX1003, ¶¶ 99–102.

86. Moreover, Apple’s first and second purported benefits contradict each other as “precisely directing the light ... closer to the photodiodes” and “directing light towards a larger area” describe opposite effects. *Compare* Petition, 32–33 *with*

id. at 33–34. Apple does not explain how any optical material from Shie could purportedly achieve opposite effects.

87. Accordingly, Apple failed to demonstrate a motivation to combine Sarantos and Shie for the same reasons already decided in IPR2022-01465.

2. Apple Fails to Demonstrate that Sarantos and Shie Changes the Shape of Light as Claimed

88. Claims 1 and 19 recite emitters that emit light in a “first shape” and a “material configured to change the first shape into a second shape.” Apple previously represented that “the relevant comparison is between the shape of light when it reaches the [material] and the shape of light when it emerges from the [material]” when discussing the similar limitation from the ’745 Patent in the ITC Investigation. EX2074, 65:20-23. Yet Apple did not provide that comparison here. Instead, Apple has failed to show that Sarantos and Shie discloses or renders obvious the “change the first shape into a second shape” limitation for Claims 1, 19.

89. First, it is unclear what the Sarantos-Shie combination even entails. Despite presenting this combination of references in multiple proceedings, including the ITC Investigation and other IPRs, Apple has not identified what disclosure in Shie is to be combined with Sarantos. Shie has nothing to do with physiological monitoring. Instead, it provides descriptions of over a dozen different types of optical elements across 22 figures, including a Fresnel lens, two different cylindrical lenses, a parabolic convex lens, a fiber optic cable, a prismatic element, a polarizer,

a wave guide filter grating, and a parabolic concave lens. EX1007 at Figs. 1a-11, 4:49–5:25. In the Petition, Apple argues that it would have been obvious to a POSITA to “use *the light shape changing material of Shie* in the wristwatch sensor of Sarantos to implement Sarantos’ region 2226” to satisfy the limitation. Petition, 31. However, Apple never explains *which* particular optical component in Shie is the “light shape changing material of Shie” that a POSITA would use in its hypothetical implementation of Sarantos’ region 2226. Instead, Apple vaguely refers to numerous optical components disclosed by Shie. Apple notes that “Shei [sic] provides *numerous examples* of various lens shapes and structures that provide the disclosed light shaping functionality.” *Id.* (referring to EX1007, Figs. 1a-8b). Apple further states that “Shie gives *numerous examples* of how such a light shaping element can be beneficially implemented in the resulting combination.” Petition, 36. Apple then references a variety of optical elements in Shie, including a “parabolic convex lens,” a “lightpipe,” a “cylindrical lens,” and a “Fresnel lens” that “may be formed in any number of shapes, configurations and contours.” *Id.*, 36–38. But again, it is not clear which of the many optical elements is supposed to be combined with Sarantos and evaluated for purposes of determining whether it discloses the “material configured to change the first shape into a second shape” limitation. Without clearly identifying the proposed combination, it is impossible to evaluate whether the Sarantos-Shie combination satisfies the “change the first shape

into a second shape” limitation. Dr. Anthony’s declaration largely copies the Petition and is similarly vague as to the combination. *See* EX1003, ¶¶ 96–98.

90. Apple also does not explain how Sarantos, combined with some unspecified optical element from Shie, would in fact change the shape of the light as claimed. Apple first relies on Shie’s description of a *diffuser* with “a plurality of surface *micro-structures*” that “are designed to homogenize light passing through” the diffuser “to produce a predetermined pattern of smoothly varying, non-discontinuous light existing” the diffuser. Petition, 30 (citing EX1007, 6:61–7:7, Abstract; EX1003, ¶¶ 94–95). However, a POSITA would have understood that this merely describes light diffusion—i.e., Shie’s diffuser with surface micro-structures could diffuse light. A POSITA would have also understood that mere light diffusion does not necessarily change a first shape of light into a second shape. This is confirmed by the teaching in the ’159 Patent. Specifically, the ’159 Patent specification teaches that a diffuser should be “*further configured to define a surface area shape* by which the emitted spread light is distributed onto a surface of the tissue measurement site.” EX1001, 3:7–10. That disclosure indicates to a POSITA that a diffuser, in and of itself, is not a material that necessarily changes the shape of light. Rather, a diffuser needs to be “further configured” to change the shape of light. The ’159 Patent claims also confirm that there is a difference between a “diffuser” and a “material configured to change the first shape into a second

shape.” Specifically, Claim 18 depends from independent Claim 14 and further specifies that the “diffuser” recited by Claim 14 “comprises a material configured to change the first shape into a second shape.” I understand that under claim differentiation, dependent Claim 18 adds a limitation to Claim 14 which is not necessarily present in Claim 14. A POSITA would therefore understand that a “diffuser” is broader than “a material configured to change the first shape into a second shape,” and that a diffuser does not necessarily disclose the “material configured to change the first shape into a second shape.” I also understand that this was also confirmed by the ITC as it previously concluded that the same disclosure in the ’745 Patent specification indicates light diffusion which “in itself, does not necessarily provide changes in ‘shape.’” *See* EX2003, 190 n.71. As such, Apple has not shown that a POSITA would have understood that Shie’s diffuser with “a plurality of surface micro-structures” would change the shape of light as required by the claims.

91. Apple and Dr. Anthony further rely on Shie’s disclosure that in addition to the surface micro-structures, the diffuser may also have “macro-optical characteristics” and that together they would yield “a light diffusing and shaping advantages.” Petition, 30–31, 36–67 (citing EX1007, 6:44–7:7, Abstract); EX1003, ¶¶ 96–98. However, Shie’s vague references to “shape” and “shaping” do not describe a change in the shape as claimed by the ’159 Patent. For example, Shie

does not explain what it means by “shape” or “shaping,” and importantly, whether it is referring to the first shape of light that is incident on an optical material being a different shape (not just a different size) than the shape exiting the optical material. *See id.* As such, Apple also has not shown that Shie’s vague reference to “light diffusing and shaping advantages” discloses the “material configured to change the first shape into a second shape” limitation.

92. Lastly, Apple lists a “parabolic convex lens,” “lightpipe,” “conventional cylindrical lens,” and “Fresnel lens” as examples that would change the shape of light. Petition, 36–37. However, Apple’s reasoning falls short for each of its examples. Notably, Apple provides *no evidence from testing* to show how the shape of light would allegedly change. Dr. Anthony’s speculations also contradict Apple’s and Dr. Sarrafzadeh’s arguments and opinions in the ITC and the Delaware Litigation, as explained below.

93. Regarding Shie’s “parabolic convex lens,” Apple argues that its microstructures at the outer edge would narrow the light distribution while those in the middle would broaden the light distribution. Petition, 37 (citing EX1007, 7:8–27; EX1003, ¶ 108). However, a POSITA would have understood that broadening or narrowing the light distribution describes changing the size of the shape of light, not changing its shape.

94. Regarding Shie’s “lightpipe,” Apple references Shie’s description of FIG. 11 that micro-structures integrated on top surface would “homogenize, shape, and direct light exiting the lightpipe.” Petition, 37 (citing EX1007 9:36–45, 10:10–15). But Shie’s lightpipe makes no sense in a physiological monitoring device. Apple does not even attempt to explain how such a lightpipe would be integrated into Sarantos. Shie describes such a lightpipe as for use in “laptop computers,” not for physiological sensors. EX1007 at 9:36–45. Moreover, there is no disclosure that such a lightpipe would change the shape of light as recited by the ’159 Patent claims.

95. Regarding Shie’s “cylindrical lens,” Apple relies on Shie’s disclosure that “a beam of light entering the lens remain unaffected in its width and is spread by the cylindrical lens contour in a direction perpendicular to its width.” Petition, 37 (citing EX1007, 1:20–24). Apple concludes that “a POSITA knew that such a conventional cylindrical lens would change Sarantos’ circular shaped light beam ... into an ellipse shap[e] ... and Sarantos’ square shaped light beam ... into a rectangular.” *Id.* However, this merely describes a cylindrical lens’ capability to project light at a distance away and not appearance of the light as it emerges from the lens. Apple previously represented that the “relevant comparison is between the shape of the light when it reaches the [material] and the shape of the light when it emerges from the [material].” EX2074 at 65:20–23. Shie’s disclosure does not answer the relevant question for obviousness.

96. Dr. Anthony’s declaration also does not demonstrate that a cylindrical optical element from Shie would change the shape of light. First, Dr. Anthony relies on a different reference, Suzuki, for its discussion of how a laser beam would interact with a concave lens—not the convex cylindrical lenses disclosed in Shie. EX1003, ¶ 109. The emitters in Sarantos are also LEDs, not lasers. *See generally* EX1005. Dr. Anthony also argues that “a conventional cylindrical lens would change Sarantos’s square shaped light beam (APPLE-1005, FIG. 18, square shaped light-emitting devices 1810) entering the cylindrical lens into a rectangle shaped light beam exiting the lens.” EX1003, ¶ 110. Again, Dr. Anthony presented no evidence of such a change. Dr. Anthony’s premise that there would be a “square shaped light beam” also contradicts his later testimony during deposition that the shape of light from a square-shaped LED is “unknown.” EX2107, 110-19:111:14. Dr. Anthony also contradicts Apple’s Delaware and ITC expert, Dr. Sarrafzadeh, who testified that a square-shaped light emitter emits circular beams of light due to Lambertian emission. *See, e.g.*, EX2050, 160, 166–168.

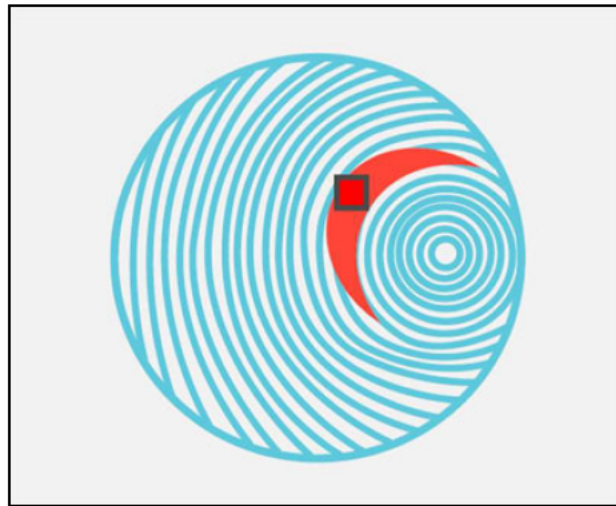
97. Regarding Shie’s “Fresnel lens,” Apple quotes Shie’s disclosure stating that a Fresnel lens’ “macro-optical characteristics” could be determined by a variety of factors including its size, cross-sectional shape, curvatures, and frequency of the continuous rings. Petition, 37–38 (citing EX1007, 6:3–28). Apple concludes that a POSITA would thus have found it obvious that the shape of the Fresnel lens

determines the shape of the light exiting the Fresnel lens. *Id.* But again, Apple's discussion does not demonstrate that the Sarantos-Shie combination actually results in a change in the shape of light as claimed.

98. Apple also relies on Dr. Anthony's declaration to support its Fresnel lens argument. Petition, 38 (citing EX1003, ¶ 111). But Dr. Anthony does not cite any evidence regarding a Fresnel lens. EX1003, ¶ 111. Instead, he cited EX1053, a textbook called "Laser Beam Shaping" and pages within that textbook discussing microlens diffusers, which are **not** Fresnel lenses.

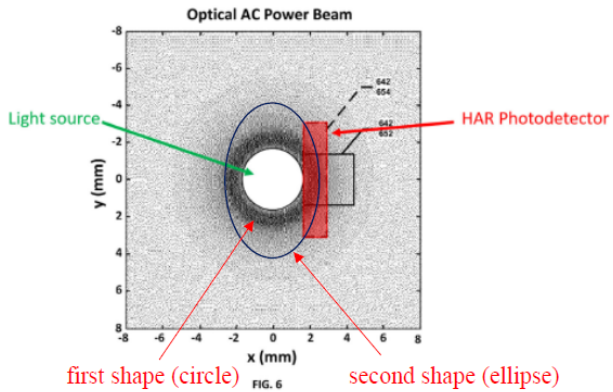
99. Dr. Anthony also opines that "a square shaped Fresnel lens ... would change Sarantos's circular shaped light beam ... into a square shaped light beam exiting the lens" and that "a circle shaped Fresnel lens ... would change Sarantos's square shaped light beam ... into a circle shaped light beam exiting the lens." EX1003, ¶ 111. However, Dr. Anthony provided **no** evidence of such a change in shape. Again, I note that Dr. Anthony's opinions contradict the opinions of Apple's other expert, Dr. Sarrafzadeh, who opined that square-shaped LEDs emit circular shapes of light, not square-shaped light beams. EX2093, 184-185; EX2050, 160, 166-168; EX2098, ¶¶47, 229-230. Notably, Dr. Anthony later stated during deposition that the shape of light from a square-shaped LED would be "unknown," rather than a square-shaped light beam. EX2107, 110:19-111:14.

100. Further, Apple argued in the ITC that a circular Fresnel lens would change the shape of light into a crescent, not into a circular shape as it argued in this IPR. Apple’s crescent-shape theory in the ITC was also unsupported by evidence. The following is Dr. Sarrafzadeh’s illustration of how he thought a Fresnel lens would change the shape of light from a square LED into a crescent:

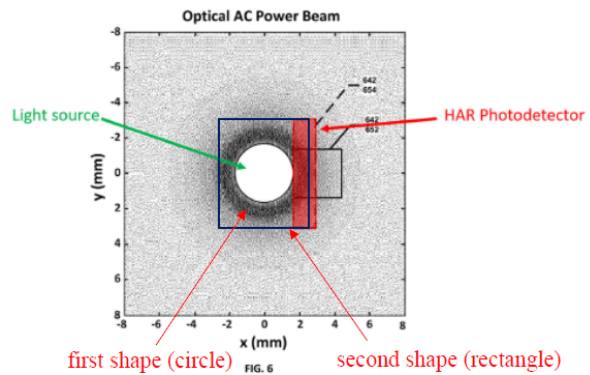


EX2042, 220. In my opinion, Apple cannot demonstrate that the Sarantos-Shie combination meets the “material configured to change the first shape into a second shape” limitation when its various experts fundamentally disagree.

101. Moreover, Dr. Anthony’s declaration demonstrates that his opinions are incorrect. Specifically, Dr. Anthony included the following two annotated diagrams of Sarantos’ Figure 6 to illustrate how he believes an alleged “first shape (circle)” would change into a “second shape (ellipse)” or a “second shape (rectangle)”:



APPLE-1005, FIG. 6 (annotated)



APPLE-1005, FIG. 6 (annotated)

EX1003, ¶ 102 (annotations by Dr. Anthony). However, these diagrams demonstrate that Dr. Anthony has misinterpreted the prior art and the claim language. None of those are the claimed “first shape” and “second shape” recited in Claim 1 and 19.

102. Claims 1 and 19 require “a plurality of emitters configured to emit light in a first shape” and a “material configured to change the first shape into a second shape by which the light ... is projected towards [a surface of] the tissue measurement site.” Thus, the “first shape” is the shape received by the material and the “second shape” is the shape exiting the material. *see* EX2074 at 65:18–23 (Apple argued in the ITC, “the requirement is to change the first shape into a second shape at the material, at the material. So the relevant comparison is between the shape of the light when it reaches the MLA and the shape of the light when it emerges from the MLA.”).

103. In contrast, in the two annotated diagrams, Dr. Anthony identified a dark ring originally shown in Figure 6 of Sarantos as the “first shape” and his own

drawing of an ellipse and a rectangle as the “second shape.” See EX1003, ¶ 102 (annotating EX1005, FIG. 6). The dark ring in Figure 6 of Sarantos cannot be the “first shape” because it does not depict the shape of light emitted by Sarantos’ light emitter and received by the material. See EX2074 at 65:18–23 (Apple arguing in ITC, “the requirement is to change the first shape into a second shape at the material, at the material. So the relevant comparison is between the shape of the light when it reaches the MLA [material] and the shape of the light when it emerges from the MLA [material].”). Rather, Sarantos explains: “FIG. 6 depicts a simulation of the AC intensity or power of *light that is emanated within a 16 mm by 16 mm region of skin as a result of light that is shined into the skin at the center of the region.*” EX1005, 6:5–8; see also *id.* at 10:51–11:3. In other words, the dark ring shown in Figure 6 is the light that is scattered back out from the user’s tissue after it has already entered the user’s tissue. It is **not** the “first shape” of light that is emitted by the LED.

104. For the same reasons, Dr. Anthony’s drawing of ellipse and rectangle on Sarantos’ Figure 6 are not the “second shape.” Dr. Anthony’s opinions regarding the “material configured to change the first shape into a second shape” are therefore incorrect. The Sarantos-Shie combination therefore does not disclose the required change from a “first shape” into a “second shape” and Dr. Anthony’s misapplication of the claim language to the prior art also does not demonstrate a motivation to combine.

105. In view of the above, it is my opinion that Apple has not demonstrated that Claims 1 and 19 of the '159 Patent would have been obvious in view of the Sarantos-Shie combination.

C. Determining Oxygen Saturation At the Wrist Would Not Have Been Obvious to a POSITA (Claims 8, 17)

106. Claims 8 and 17 depend from Claims 1 and 14, respectively, and further require “the physiological parameter comprises oxygen saturation.” Further, because Claims 1 and 14 specify the measurement takes place at the wrist (Limitations [1.2], [14.1], [14.2]), Claims 8 and 17 require the determination of oxygen saturation at the wrist. 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. No Disclosure in Sarantos of Determining Oxygen Saturation at the Wrist

107. Sarantos does not disclose determining oxygen saturation at the wrist. Apple relies on Sarantos’ passing mention of oxygenation levels and “red *or* infrared” light. Pet., 43 (citing EX1005, 13:44-53). 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.

108. 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 Had a Reasonable Expectation of Success in Determining Oxygen Saturation at the Wrist in 2015

109. Apple alleges that modifying Sarantos to measure oxygen saturation at the wrist “would be obvious” to allow people exercising, flying planes, or climbing mountains to check their oxygen saturation. Pet., 25. But that argument is circular and says nothing more than adding an oxygen saturation would allow a user to check their oxygen saturation. Apple also argues that “such techniques were well-known in the art well before 2015.” *Id.* But in 2015, a POSITA would not have had a reasonable expectation of success in measuring oxygen saturation at the wrist because it had never been done before in any commercial wrist-worn oximeter.

110. Sarantos is a patent filed by and assigned to Fitbit, Inc., a company well-known for making wearable fitness trackers. EX1005, Cover. Yet, 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.

111. 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.

112. 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. They did not yet exist.

113. 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] [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

Mannheimer to [REDACTED]

[REDACTED] EX2080, 173:9-173:13;

EX2077, 1012:12-25. Mannheimer 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. Mannheimer 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.

114. Mannheimer 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 Mannheimer worked on previously “operated on a much more vascularized

tissue bed, usually fingers or forehead” and “the wrist is just an incredibly different

beast”). Mannheimer 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.

115. 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]

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

[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.

116. 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]

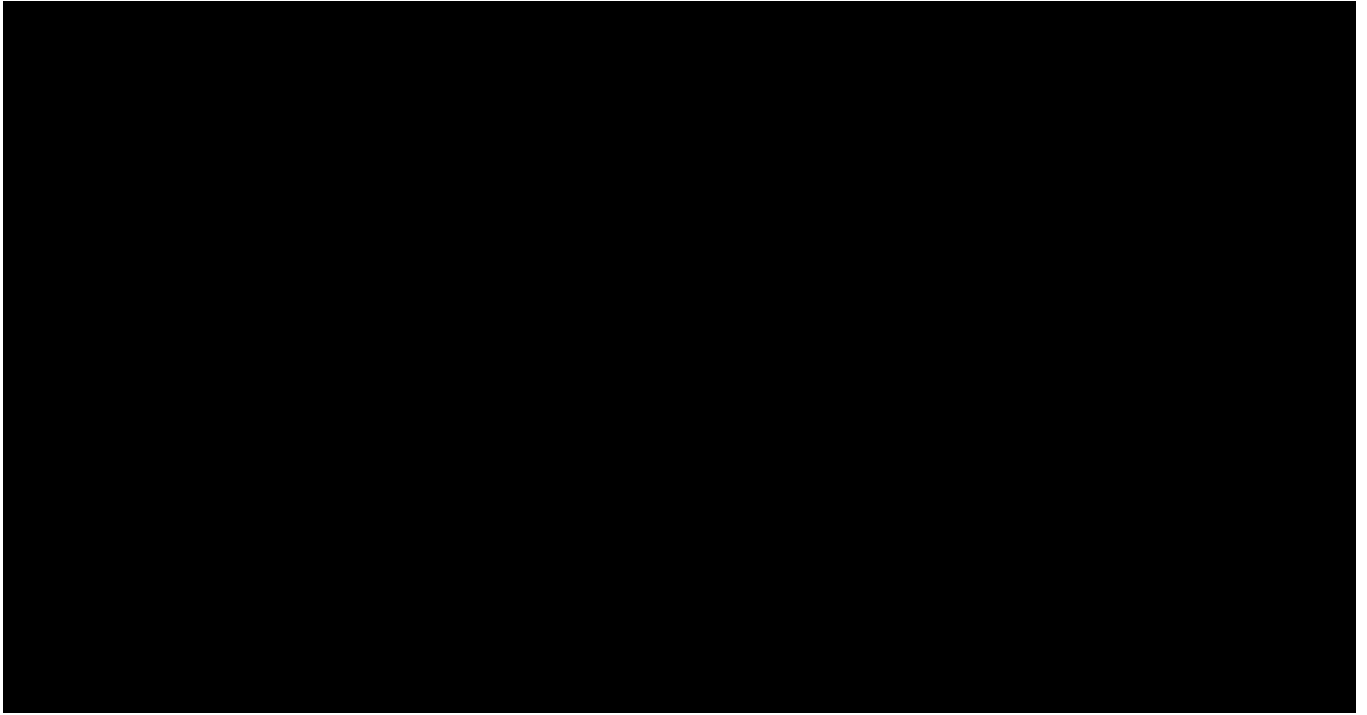
EX2082, 108:13-21.

117. 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 '159 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]

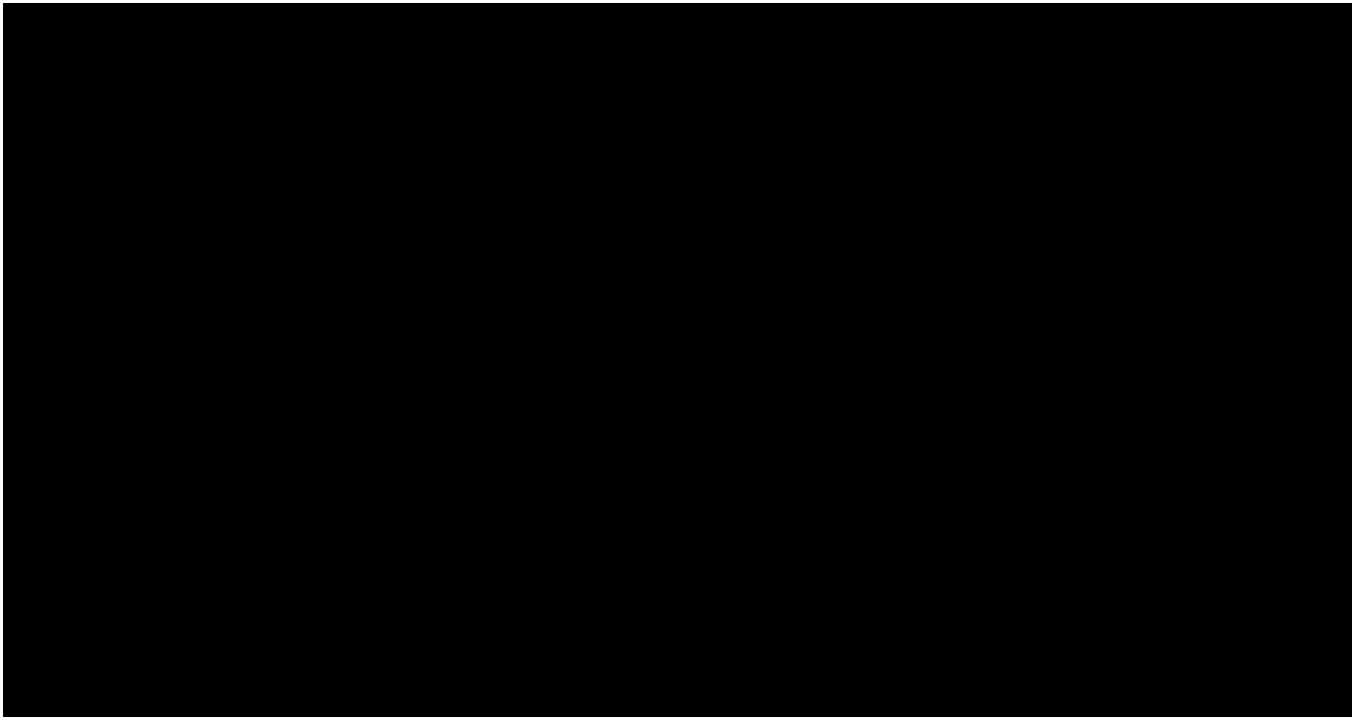
[REDACTED] could work at the wrist. EX2085, 7. They determined those conventional methods would not work at the wrist.

[REDACTED]

[REDACTED] *Id.* 7-9.



Id. at 8.



Id. at 9.



[REDACTED] *Id.* [REDACTED]

[REDACTED] *Id.* at 9.

118. Apple’s engineers even remarked that “Conventional sensing methods do not result in waveforms that are consistent enough for SpO₂ 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., 26.

119. Additionally, Mannheimer revealed that in their 2015 research, Apple’s engineers were not yet measuring oxygen saturation at all. He testified that [REDACTED]

[REDACTED] between red and infrared light.

EX2094, 26:2-28:2. But even then, Mannheimer explained that they were getting

[REDACTED]

EX2094, 28:3-29:19.

120. 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.

121. 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]

122. 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 [REDACTED]

EX2085,12.

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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.

124. 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 '159 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.

3. Apple's References Do Not Establish A Reasonable Expectation Of Success

125. I understand that Apple argues that measuring oxygen saturation at the wrist was "well-known in the art well before 2015" based on six references. Pet., 25-26 (citing Sarantos, EX1014-EX1016, EX1018, EX1021). 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.

126. 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 well before 2015." 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 the Board previously held, the requirement to “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.

127. Sarantos (EX1005) does not disclose measuring oxygen saturation at the wrist at all, as explained above. *Supra* §VIII.C.1.

128. 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.*, EX2085, 5 [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. [REDACTED]

[REDACTED] 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.

129. 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]

[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.

130. 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.

131. 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.

132. 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.

133. 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 form

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 SpO₂ measurements at the wrist." EX2085, 13.

134. Additionally, Apple's cited references do not demonstrate a reasonable expectation of success in modifying Sarantos's sensor design to determine oxygen saturation at the wrist. None of the cited references relate to a sensor design that is similar to Sarantos's. For example, none of the references use Sarantos's HAR photodetectors, let alone use a material that changes the shape of light as further

required by the claims. 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.

4. Objective Evidence of Industry Skepticism, Failure of Others, and Long-Felt But Unmet Need Further Support Nonobviousness

135. Claims 8 and 17 require determining oxygen saturation at 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.

136. 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].

137. 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]
[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.

138. 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]
[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 SpO₂ 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] not restricted to the form factor of an Apple Watch. EX2085, 7, 12.

139. 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, [REDACTED]
[REDACTED] EX2085, 7-13. Apple’s engineers concluded that “Conventional sensing methods do not result in waveforms that are consistent enough for SpO₂ measurements from the wrist.” EX2085, 13. Mannheimer also explained that in 2015, [REDACTED]
[REDACTED]
[REDACTED] EX2094, 28:3-29:19.

140. 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.

141. Additionally, the references that Apple cited to support reasonable expectation of success (EX1005, EX1014-EX1016, EX1018, EX1021) 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.

142. 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.

IX. CONCLUSION

143. 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.

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