

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,

Petitioner,

v.

MASIMO CORPORATION,

Patent Owner.

IPR2024-00244

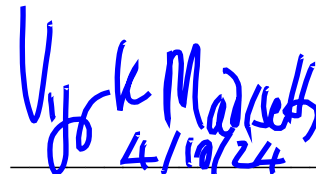
U.S. Patent 10,722,159

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: 4/10/24



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. Madisetti, “All-Digital Oversampled Front-End Sensors” IEEE Signal Processing Letters, Vol. 3, Issue 2, 1996; “LMSGEN: A Prototyping Environment for Programmable Adaptive Digital Filters in VLSI,” VLSI Signal Processing, pp. 33–42, 1994.

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

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

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

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

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

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

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

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

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

II. MATERIALS AND INFORMATION CONSIDERED

22. I have been asked to provide technical expert opinions relating to the validity of the claims of the '159 Patent. In forming my opinions expressed in this Declaration, I have reviewed and considered the '159 Patent's claims, specification, drawings, and file history. I have also reviewed and considered Apple's petition, the prior art references that Apple relies on, the Declaration of Dr. Brian Anthony accompanying each petition, and all other exhibits Apple submitted in this proceeding. Additionally, I was asked by Masimo to provide opinions with respect to all four IPRs that Apple filed challenging claims of the '743 and '159 Patents (IPR2024-00241, -00242, -00243, and -00244). I have also reviewed the petitions and materials submitted in connection with those IPRs.

23. As mentioned above in Section I, 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. I have also been provided with and considered all publicly filed papers and exhibits from IPR2022-01291 and IPR2022-01465 relating to the '745 Patent. I note that various documents in IPR2022-01291 and IPR2022-01465 were filed under seal. While counsel has not provided me with copies of the papers and exhibits that were filed under seal in IPR2022-01291 and IPR2022-01465, I understand that the information under seal originated from testimony and documents in the ITC Investigation and relate to reasonable expectation of success and objective indicia of nonobviousness. I previously provided expert testimony in the ITC Investigation based on those documents. I also provided opinions based on those documents in the Delaware Litigation, as well as additional documents from the Delaware Litigation that are not yet available in these IPRs. I reserve the right to supplement my opinions if/when those additional documents become available for me to rely upon in these IPRs.

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
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

Exhibit No.	Description
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

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.

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.

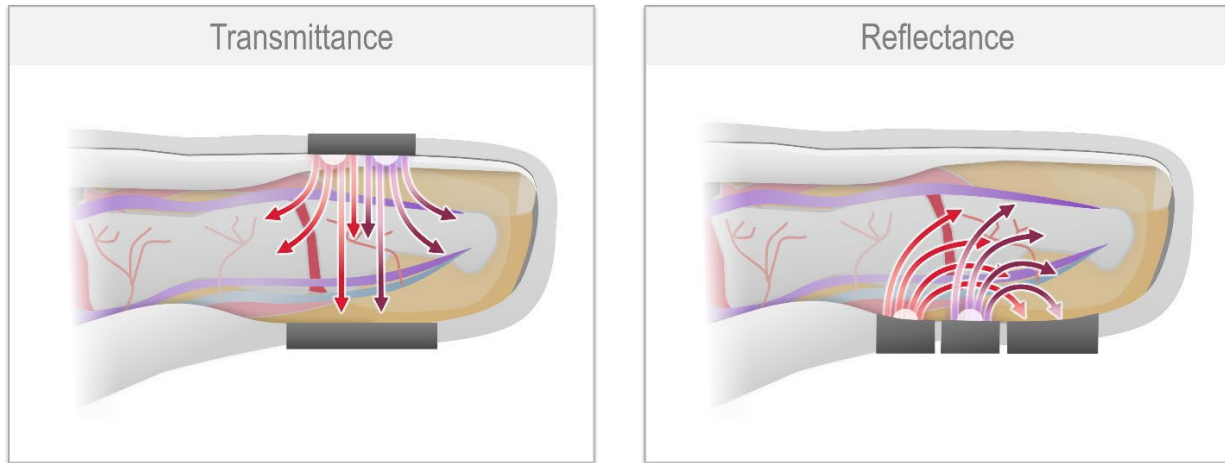
IV. BACKGROUND OF THE TECHNOLOGY

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* EX1001, 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* EX1009, 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.*, EX1001 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. EX2029, 248:24-250:14.



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

C. Apple's Asserted References

1. 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 photoplethysmographic techniques for measuring heart rate.” *Id.* at 18:35–44. Sarantos cautions that “although it is contemplated that the photodetector element concepts discussed herein may see similar performance with light sources that emit light predominantly in the 500 nm to 600 nm range, which *includes yellow light as well as some light orange light*,” the invention is “*not* tailored for use in other spectrums, *such as the red or infrared spectra*,” which Sarantos recognizes as the wavelengths used in blood oxygenation measurements. *Id.* at 18:35–51.

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. The relevant field of art is devices and sensors for the non-invasive measurement of physiological parameters such as blood oxygen saturation. *See, e.g.*, EX1001 at 1:22–26 (“The present disclosure relates to the field of non-invasive optical-based physiological monitoring sensors, and more particularly to systems, devices and methods for improving the non-invasive measurement accuracy of oxygen saturation, among other physiological parameters.”).

49. I understand that the level of ordinary skill in the art for the ’159 Patent is measured as of July 2, 2015, which is the effective filing date of the ’159 Patent. In my opinion, a person of ordinary skill in the art as of the effective filing date of the ’159 Patent would have been a person with a working knowledge of physiological monitoring technologies and/or optical sensors used in physiological monitoring technologies. The person would have had a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, software, or optical technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information, or designing and using optical sensors or systems, including but not limited to physiological monitoring technologies. Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline.

50. As explained above, based on my education and experience, I met and exceeded the qualifications for a POSITA prior to the effective filing date of the '159 Patent.

51. I have reviewed Apple's definition of a POSITA for the '159 Patent. Apple's definition is slightly different than mine. However, the difference is not material to the issues in this proceeding. I also met and exceeded the qualifications for a POSITA as defined by Apple.

VI. CLAIM CONSTRUCTION

A. "change the first shape into a second shape"

52. 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 have been asked to provide my opinions regarding the construction of the phrase "change the first shape into a second shape" as it appears in the Claims 1 and 19, as well as claims depending from Claims 1 and 19.

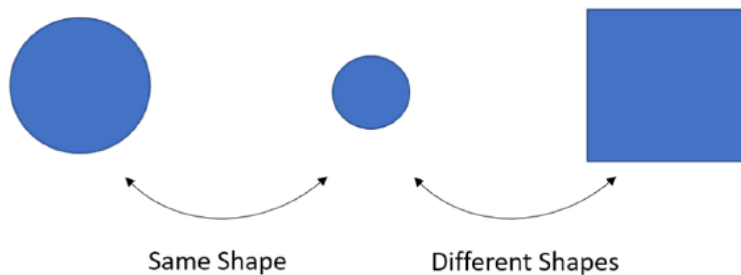
53. I understand that Apple takes the position in this IPR that no claim terms need be construed and all claim terms should be given their ordinary and customary meaning according to the *Phillips* standard. Petition at 5. However, that is inconsistent with the position that Apple took in the Delaware Litigation. In the

Delaware Litigation, Apple and Masimo agreed that the term “second shape” in Claims 1 and 19 should be construed as “shape different from the first shape (not just a change in size).” EX2038, 5.

54. Apple’s obviousness arguments fail under the parties’ previously agreed construction. For example, Apple now argues that the “material configured to change the first shape into a second shape” limitation is met by a “translucent or transparent” window in Sarantos because “light shining through translucent or transparent material would change in shape due to the refractive properties of translucent and transparent materials.” *See, e.g.*, Petition at 9–10. However, that is not true. Merely referencing light refraction is not sufficient to demonstrate a change in the shape of light. A window that is translucent or transparent does not, in and of itself, change the shape of light. It would not necessarily even change the size of the shape of light. Moreover, I understand that Masimo overcame prior art during prosecution of a related application that disclosed a lens, which is a type of translucent or transparent material which refracts light. *See* EX2056, 40, 59–60, 162. Therefore, it is my opinion that the “change the first shape into a second shape” limitation in the ’159 Patent claims should be construed consistent with Apple’s prior agreement.

55. Consistent with the parties’ prior agreement, the phrase “change the first shape into a second shape” means that the claims require a material that is

configured to change the first shape into a shape different from the first shape (not just as a change in size). For example, if the first shape of light were a circle, a smaller circle would not be considered a second shape. But a square would be considered a different shape than a circle.¹



56. First, the claim’s plain language would have informed a POSITA that it requires the material to “**change** the first shape into a second shape.”² The requirement that there be a “change...into” would indicate to a POSITA that the second shape must be different than the first shape. Otherwise, it would render the limitation meaningless. I note that this is also consistent with the ordinary and

¹ Where appropriate, I may reproduce figures and annotations from Dr. Duckworth’s prior declarations in IPR2022-01291 and IPR2022-01465. I have reviewed the public versions of his declarations (EX2002, EX2070, and EX2100 in IPR2022-01291 and -01465) and his prior opinions are consistent with my opinions.

² All emphases are added unless stated otherwise.

customary meaning of the word “change,” which is “[t]o make different.” *See* EX2072.

57. Second, the specification supports the previously agreed-upon construction. The ’159 Patent uses the term “shape” when describing light, in accordance with its ordinary and customary meaning, e.g., rectangular, squares, circles, and donuts. The specification contains several examples of a material changing a first shape into a second shape. *See* EX1001, 7:63–8:14, 10:65–11:2. For example, the specification explains that a diffuser 304 can “distribut[e] the emitted light on the surface of a plane (e.g., the surface of the tissue measurement site 102) in a predefined geometry (e.g., a rectangle, square, or circle), and with a substantially uniform intensity profile and energy distribution.” *Id.* at 8:9–14. As another example, the specification explains that in Figure 7A, a “light diffuser 704 receives the optical radiation emitted from the emitter 702 and homogenously spreads the optical radiation over a wide, donut-shaped area.” *Id.* at 10:65–11:2. Thus, for example, intensity can, but not necessarily, affect shape if it can create new geometries, like for example, a circle inside another circle, as in the difference between a circular disk and a donut.

58. Third, the prosecution history of a related application (App. No. 16/532,065) supports the construction that a change in size is not a change in shape as required by the claims. The ’065 Application is a parent application to the ’159

Patent. During prosecution of the '065 Application, Masimo submitted a preliminary amendment which introduced a new claim 2 reciting the limitation: “a material positioned between the plurality of emitters and the tissue measurement site, the material configured to alter a shape of the light emitted from one or more of the plurality of emitters before the light reaches the tissue measurement site.” EX2056 at 40 (Sept. 16, 2019 Preliminary Amendment at 4).

59. On October 21, 2019, the Patent Office rejected the then-pending claim 2 based on two prior art references, Fei (U.S. Pat. App. 2014/0361147) and Scharf (U.S. Pat. 5,830,137). EX2056 at 59–60, 69–71 (Oct. 21, 2019 Office Action at 3–4, 13–15). In the office action, the Examiner relied on lenses in Fei and Scharf for teaching the “material configured to alter a shape of the light.” *Id.* at 59.

60. In a November 14, 2019 response to the office action, Masimo amended the relevant portion of claim 2 as follows:

a material positioned between the plurality of emitters and a[[the]] tissue measurement site, the material configured to ~~alter a shape of~~distribute the light emitted from one or more of the plurality of emitters ~~before the light reaches the tissue measurement site~~to form a customized shape on a surface of the tissue measurement site;
a plurality of detectors configured to detect the light after attenuation by tissue, the plurality of detectors further configured to output at least one signal responsive to the detected light;

EX2056 at 82 (Nov. 14, 2019 Amendment at 2).

61. Then, on January 7, 2020, Masimo filed a supplemental amendment,

further amending claim 2 as follows:

a material positioned between the plurality of emitters and a ~~the~~ tissue measurement site, the material configured to alter a shape ~~[[of]]~~ by which the light emitted from one or more of the plurality of emitters is distributed onto a surface of ~~before the light reaches~~ the tissue measurement site;

EX2056 at 113 (Jan. 7, 2020 Amendment at 2).

62. On February 13, 2020, Masimo interviewed the application with the Examiner. *Id.* at 162 (March 23, 2020 Summary of Interview at 1). 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.*.

63. On March 9, 2020, the Examiner issued a Notice of Allowability. *Id.* at 151 (March 9, 2020 Notice of Allowance). With Masimo’s authorization during an interview, the Examiner amended claim 2 by inserting the “first shape” and “second shape” limitations:

a material positioned between the plurality of emitters and a tissue measurement site on a wrist of a user, the material configured to alter ~~the~~ a first shape into a second shape by which the light emitted from one or more of the plurality of emitters is distributed onto a surface of the tissue measurement site;

Id. at 157 (March 9, 2020 Notice of Allowance at 2).

64. Based on the amendments, the interview summary which explained that Masimo and the Examiner agreed that the claim amendments reflect a change in shape of emitted light beyond a change in size, and the Examiner's subsequent amendment after the interview introducing "first shape" and "second shape" into the claim, a POSITA would understand that merely changing the size of a "first shape" does not change it into a "second shape."

65. Therefore, it is my opinion that a POSITA would understand that the phrase "change the first shape into a second shape" means "to change the shape of light from a first shape to a shape that is different than the first shape (not just a change in size)."

VII. SUMMARY OF OPINIONS

66. 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:

- (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. Ground 1A: Sarantos alone

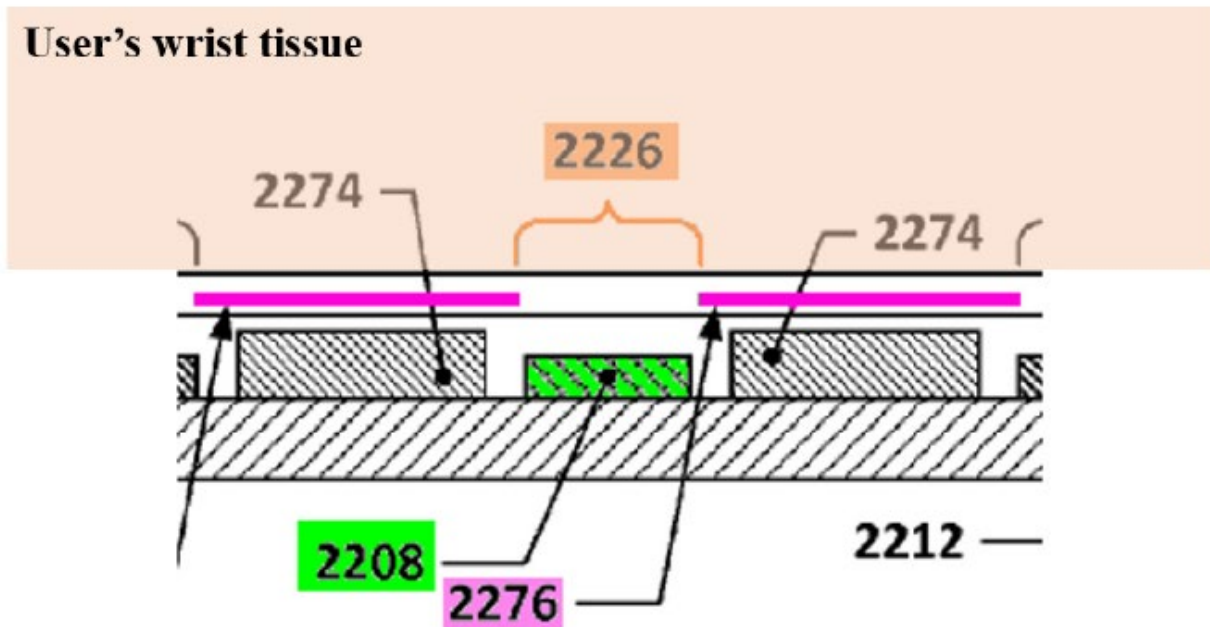
67. I understand that Apple argues that Claims 1–5, 7–9, and 12–13 would have been obvious to a POSITA in view of Sarantos alone. ’244 Petition, 5–29. I disagree. For reasons below, Apple has not demonstrated that any claim would have been obvious based on Sarantos alone.

68. Independent Claim 1 recites a “material configured to change the first shape into a second shape.” In my opinion, Apple has not demonstrated that this

limitation has been disclosed by Sarantos or that it would have been obvious over Sarantos.

69. As explained above, during prosecution of a related application, Masimo expressly distinguished the claimed “material” from a lens that merely changed the size of a shape of light. *See* Section VI. Thus, as Apple previously agreed, the claimed “second shape” must be a “shape different from the first shape (not just a change in size).” *See* EX2038, 5. Apple does not show that Sarantos discloses that change in shape. ’244 Petition, 9–10. There is no disclosure in Sarantos about a material that can change the shape of light.

70. Nevertheless, Apple asserts that this limitation would have been obvious over Sarantos. ’244 Petition, 9–10. Apple points to a “window region 2226 (orange)” in Sarantos’ Figure 22 which “may be made from translucent or transparent material.” *Id.* at 9 (citing EX1005 at 17:4–6). Apple then asserts that “[a] POSITA would have found it obvious that light shining through translucent or transparent material would change in shape due to the refractive properties of translucent and transparent materials.” *Id.* at 9–10.



'244 Petition at 9 (Apple's annotations of Sarantos' Figure 22).

71. But neither Apple nor Dr. Anthony showed that Sarantos' window would have changed the shape of light. They do not even address that the change in shape cannot simply be a change in the size of the first shape. Apple simply appears to argue that whenever light passes through a transparent or translucent window, the shape of light would change. That is not true. The shape of light does not necessarily change when passing through a transparent or translucent object. In fact, a POSITA would not have expected the shape of light passing through Sarantos' window to change. Sarantos' window is depicted as flat in Figure 22 and there is no disclosure anywhere in Sarantos regarding changing the shape of light.

72. Therefore, it is my opinion that Apple has not demonstrated that Claim 1 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 Claim 1.

73. Each of Claims 2–5, 7–9, and 12–13 depends directly or indirectly from independent Claim 1. Therefore, in my opinion, Apple has not demonstrated that it Claims 2–5, 7–9, and 12–13 would have been obvious over Sarantos.

B. Grounds 1C, 1D, and 1G: Sarantos in view of Brady; Brady and Han; and Utter

74. Apple argues in Ground 1C that Claim 2 would have been obvious over Sarantos in view of Brady. Claim 2 depends from independent Claim 1. Apple further argues in Ground 1D that Claim 3 would have been obvious over Sarantos in view of Brady and Han. ’244 Petition, 1, 44–46, and 46–50. Claim 3 depends from Claim 2 which depends from independent Claim 1. As explained above, Apple fails to demonstrate that Claim 1 would have been obvious over Sarantos because Sarantos does not disclose or render obvious the “material configured to change the first shape to a second shape” limitation. Apple’s Grounds 1C and 1D do not address this deficiency. Thus, for the same reasons, Apple fails to demonstrate that Claims 2 and 3 would have been obvious in Grounds 1C and 1D.

75. Apple argues in Ground 1G that Claims 14 and 16–25 would have been obvious to a POSITA based on Sarantos in view of Utter. ’244 Petition, 2 and 51–

68. I disagree. For reasons below, Apple has not demonstrated that any claim would have been obvious based on Sarantos in view of Utter.

76. Independent Claim 14 does not recite the “change the first shape into a second shape” limitation as found in Claim 1. In place of this limitation, Claim 14 recites: “a diffuser configured to be positioned between the plurality of optical sources and a tissue measurement site on the wrist of the user when the physiological monitoring device is in use.” In its discussion of Ground 1G, Apple’s only argument for this limitation is that its proposed Sarantos-Utter combination renders this limitation obvious “for the same reasons discussed in Ground 1B.” ’244 Petition, 57–58 (citing EX1003, ¶¶ 169–175, 118–133). Dr. Anthony’s declaration regarding this limitation in Ground 1G also simply referred to his discussion in Ground 1B without further explanation. EX1003, ¶ 171.

77. However, in Ground 1B, Apple and Dr. Anthony both rely on *Shie* to disclose a “diffuser” and both assert that their proposed combination of Sarantos *and Shie* discloses the “diffuser” limitation of Claim 14. ’244 Petition, 40–41; EX1003, ¶ 120. In contrast, Ground 1G is based on Sarantos and Utter, *without Shie*. Apple and Dr. Anthony’s Ground 1B argument is not applicable to Ground 1G, which does not rely on *Shie* at all. Thus, Apple’s Ground 1G fails to demonstrate the obviousness of Claim 14.

78. Even if Apple and Anthony both meant to reference Ground 1A, Apple still fails to demonstrate obviousness of Claim 14. Ground 1A does not address how Sarantos discloses the different “diffuser” limitation in Claim 14. *See generally* ’244 Petition, 1, 5–29. Even if considering that it is a typographical error to refer to “Ground 1B” in the Petition and the Anthony Declaration, Apple still fails to account for the “diffuser” limitation in Claim 14. Therefore, it is my opinion that Apple has failed to demonstrate that Sarantos and Utter, alone or in combination, would render Claim 14 obvious to a POSITA.

79. Claims 15–18 depend from independent Claim 14. Therefore, in my opinion, Apple has not demonstrated that Claims 15–18 would have been obvious for at least the same reasons it has not demonstrated that Claim 14 would have been obvious.

80. Independent Claim 19 recites the same “material configured to change the first shape into a second shape” limitation as in Claim 1. Apple’s argument for this limitation ([19.3]) is a cross-reference to its Ground 1A argument for limitation[1.2]. ’244 Petition, 59. Therefore, for the same reasons discussed above, Apple has not demonstrated that Claim 19 would have been obvious over Sarantos and Utter.

81. Claims 20–25 depend from independent Claim 19. Apple’s Ground 1G arguments regarding Claims 20–25 do not address the deficiency in independent

Claim 19. Therefore, Apple has not demonstrated that Claims 20–25 would have been obvious over Sarantos and Utter.

82. Accordingly, Apple’s Grounds 1C, 1D, and 1G all fail to demonstrate the obviousness of any claim.

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

83. 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). ’244 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 that Sarantos and Shie Changes the Shape of Light as Claimed

84. 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 and their dependent claims.

85. 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. ’244 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.” ’244 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.

86. 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. ’244 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.

87. 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.” ’244 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.

88. Lastly, Apple lists a “parabolic convex lens,” “lightpipe,” “conventional cylindrical lens,” and “Fresnel lens” as examples that would change the shape of light. ’244 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.

89. 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. ’244 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.

90. 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.” ’244 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.

91. 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.” ’244 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.

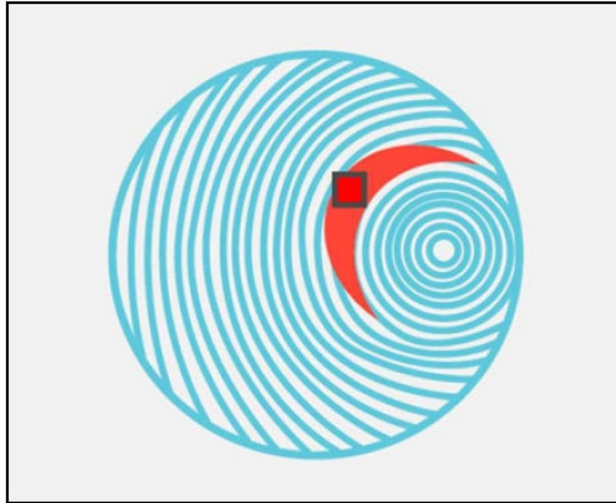
92. Dr. Anthony’s declaration also does not demonstrate that a cylindrical optical element from Shie would change the shape of light. First, Dr. Anthony relies on a different reference, Suzuki, for its discussion of how a laser beam would interact with a concave lens—not the convex cylindrical lenses 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. That is not only incorrect, but Dr. Anthony directly 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.

93. 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. ’244 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.

94. Apple also relies on Dr. Anthony's declaration to support its Fresnel lens argument. '244 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.

95. 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. I also note that in the ITC, Apple's expert, Dr. Sarrafzadeh opined (also based on his speculation) that a Fresnel lens would change the shape of light from a square LED into a crescent shape. 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.

96. Additionally, as I explain in the next section below, Dr. Anthony’s declaration also confirms that he misapplied the “first shape” and “second shape” limitations to the prior art. As I discuss below, Anthony identified shapes in his annotations to Sarantos’ Figure 6 that are *not* the “first shape” and “second shape” recited by the ’159 Patent claims. *See infra* ¶¶110–111.

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

97. 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.

98. 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 absolutely 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 an inventor to look towards combining Sarantos with Shie. There is no reason why a POSITA would have looked to Shie at all.

99. The Petition provides the same three rationales for why a POSITA would combine Sarantos and Shie that the Board previously rejected. ’244 Petition, 32–35; *See* IPR2022-01465, Final Written Decision at 142–147. First, Apple

explains 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.

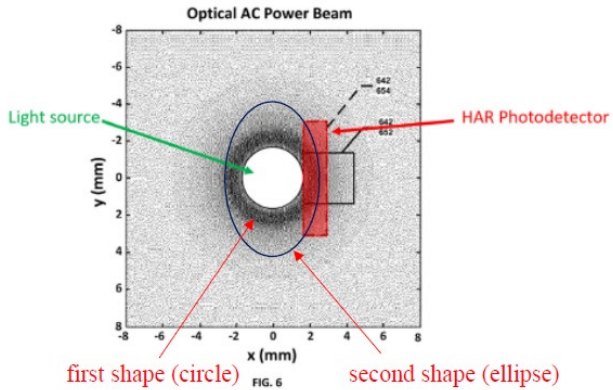
100. However, as noted above, Apple does not explain *which* optical element from Shie would be combined with Sarantos or *how* such an optical element could achieve the three alleged motivations. *See* '244 Petition at 32–35. Apple referred vaguely to "a light shape changing material (as taught by Shie)," 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.

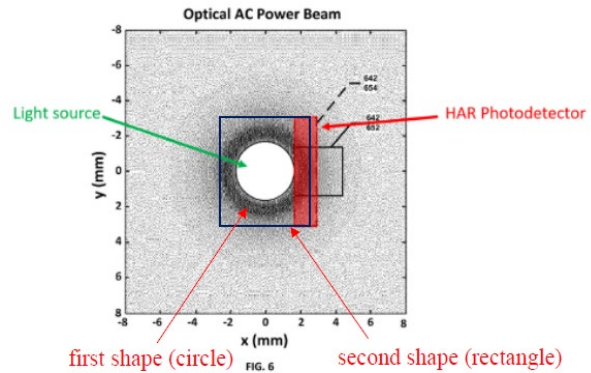
101. Moreover, Apple’s first and second purported benefits contradict each other as “precisely directing the light ... closer to the photodiodes” and “directing light towards a larger area” describe opposite effects. *Compare* ’244 Petition, 32–33 *with id.* at 33–34. Apple does not explain how any optical material from Shie could purportedly achieve opposite effects.

102. 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.

103. 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. Dr. Anthony’s two annotated diagrams reproduced above misapplied the “first shape” and “second shape” limitations to Sarantos. 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. 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.

104. In view of the above, it is my opinion that Apple has not demonstrated that any of the independent claims of the ’159 Patent would have been obvious. Accordingly, Apple also has not demonstrated that any dependent claims would have been obvious either. Therefore, it is my opinion that none of Apple’s grounds would render any of the challenged claims obvious.

IX. CONCLUSION

105. 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.

