

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

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

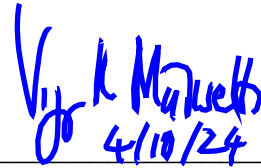
DECLARATION OF VIJAY K. MADISETTI

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

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

Date:

4/10/24


4/10/24

Vijay K. Madiseti, Ph.D.

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I, Vijay K. Madisetti, declare as follows:

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

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

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

I. QUALIFICATIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

18. I have studied, researched, and published in the area of user interface development, including on the development of user interfaces for applications on mobile platforms such as iPhone's iOS, Google's Android, or RIM's Blackberry. *See, e.g.*, N. Radia, Y. Zhang, M. Tatipamulaa, and V. 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. 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 what I understand to be the same documents. I also provided opinions based on what I understand to be the same 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
2043	ITC Final Initial Determination (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

Exhibit No.	Description
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

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.

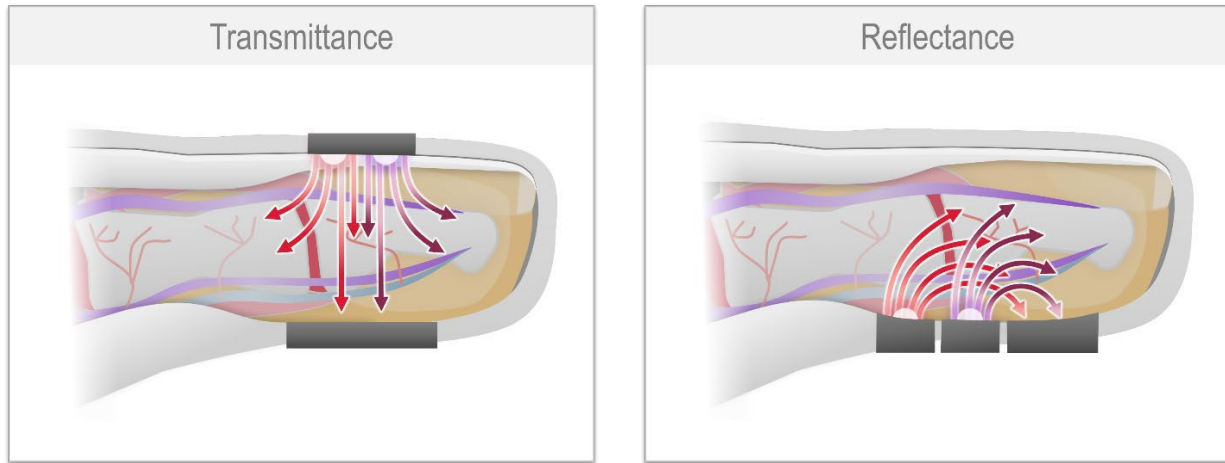
IV. BACKGROUND OF THE TECHNOLOGY

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* '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.”¹ The claims also recite a “light block configured to prevent at least a portion of the light” from the emitter from reaching

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

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

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

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

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

43. Based on Al-Ali's research and the resulting '159 Patent inventions, Masimo developed the Masimo W1™ which is a commercial medical-grade watch with a pulse oximeter that measures 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. Iwamiya (EX1004)

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

2. Sarantos (EX1005)

46. U.S. Patent No. 9,392,946 to Sarantos et al. is titled “HEART RATE SENSOR WITH HIGH-ASPECT-RATIO PHOTODETECTOR ELEMENT” and was originally assigned to Fitbit, Inc. EX1005 at Title. Sarantos’s heart rate sensors have “high-aspect-ratio” (HAR) photodetector elements that differ from conventional square photodetector elements. *Id.* at 9:48–10:15. Compared to the conventional square photodetectors, Sarantos proposes using HAR photodetectors to improve light collection capabilities while maintaining substantially the same active area. *See id.* at 10:27–50, FIG. 5. Sarantos explicitly limits its discussion on HAR photodetectors to be “*primarily with respect to light sources that emit green light*, e.g., wavelengths in the range of 500 nm to 550 nm,” which are “particularly well-suited for photoplethysmographic techniques for measuring heart rate.” *Id.* at 18:35–44.² 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

² All emphases are added unless stated otherwise.

Sarantos recognizes as the wavelengths used in blood oxygenation measurements.

Id. at 18:35–51.

3. Han and Utter (EX1008, EX1006)

47. Apple also relies upon two additional references, Han (EX1008) and Utter (EX1006) for various limitations. However, as explained below, all of Apple’s grounds fail to demonstrate obviousness because Apple fails to demonstrate that Sarantos in combination with Shie would render the independent claims obvious. I reserve all rights to supplement my opinions regarding these references and Apple’s arguments based on these references if IPR is instituted.

V. LEVEL OF ORDINARY SKILL IN THE RELEVANT ART

48. 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. Apple's Delaware Construction of "Opening" (Claims 1, 19)

52. I understand that the Board construes claim terms during IPR under the same *Phillips* claim construction standard that is applied in district court litigation.

Apple's Petition stated that "no claim terms need be construed to resolve issues of controversy in the present Petition." Petition, 5. However, in the Delaware Litigation, Apple and its expert, Dr. Sarrafzadeh, proposed a narrow claim construction of the term "opening" in Claims 1 and 19 to mean "empty space." *See* EX2037, ¶465. Apple construed "opening" to mean "empty space" based on the supposed "ordinary meaning" of the term to a POSITA, as well as Dr. Sarrafzadeh's analysis of the '743 Patent specification (which is identical to the '159 Patent's specification). *See id.* at ¶¶465, 479–482.³

53. Apple relied on that narrow construction of "opening" to argue noninfringement. Specifically, Apple argued that an opening that is filled with solid material, "such as closed windows and solid lenses" cannot satisfy the "opening" limitation. EX2037, ¶479. According to Apple's expert, "[A]n opening is an empty space. Especially in the field of optics, light traveling through space in an opening is not equivalent to light traveling through a material, such as a window." EX2037, ¶482.

³ While the redacted Sarrafzadeh report is primarily focused on the '743 Patent, Apple and Dr. Sarrafzadeh applied this construction to the '159 Patent as well, as shown by Dr. Sarrafzadeh's citation to the '159 Patent's specification throughout.

54. However, under Apple’s construction of “opening” to mean “empty space,” the Iwamiya-Sarantos combination fails to demonstrate obviousness because there is no “empty space” in the “opening” that Apple identified.

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

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

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

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

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

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

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

VII. SUMMARY OF OPINIONS

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

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

VIII. ANALYSIS

58. Each of Apple's three invalidity grounds depends on a combination of Iwamiya with Sarantos. Grounds 1B and 1C further rely on Han or Utter to disclose various limitations. However, as discussed below, each of the grounds fail to demonstrate the obviousness of the independent Claims 1, 14, and 19, and therefore fail to demonstrate obviousness of any claim.

A. The Iwamiya-Sarantos Combination Fails to Disclose [1.4], [1.5], and [19.5]

59. Claims 1 and 19 both recite “a surface comprising a dark-colored coating, the surface positioned between the plurality of detectors and the tissue when the physiological monitoring device is in use, wherein an opening defined in the dark-

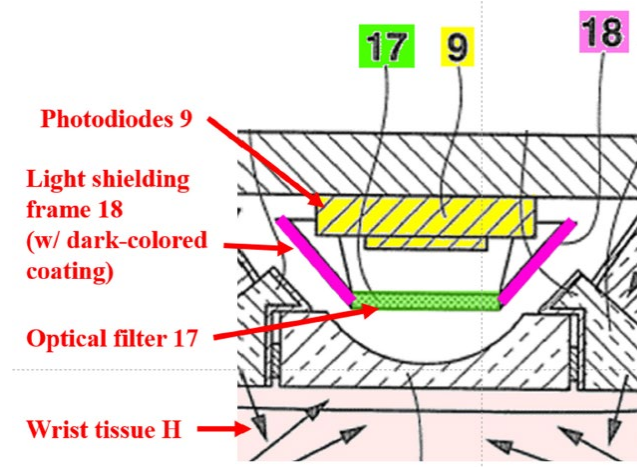
colored coating is configured to allow at least a portion of light reflected from the tissue to pass through the surface.” Apple labels this limitation as Limitations [1.4] and [1.5] for Claim 1 and Limitation [19.5] for Claim 19. However, under both Apple’s and Masimo’s claim constructions, the Iwamiya-Sarantos combination does not disclose this limitation.

1. The Optical Filter in the Iwamiya-Sarantos Combination Is Not Empty Space

60. As explained above, Apple construed the term “opening” to mean “empty space” in the Delaware Litigation. Apple explained that an opening that is filled with solid material, “such as closed windows and solid lenses” cannot satisfy the claim limitation. EX2037, ¶479. Under that construction, the Iwamiya-Sarantos combination cannot satisfy the claim limitation because the “optical filter 17” that Apple identified as the “opening” is a solid material, not empty space.

61. As illustrated in the figure below, Apple identified Iwamiya’s “light shielding frame 18” as the recited “surface.” Petition, 21 (“the Iwamiya-Sarantos combination includes a ‘light shielding frame 18’ (the claimed ‘surface’) surrounding the photo diodes/light receiving units 9 ... with a dark-colored coating, as taught by Sarantos”); *see also id.* at 65 (Apple’s argument for [19.5] cross-references its [1.4], [1.5] arguments). Under Apple’s obviousness theory, a POSITA would have coated the light shielding frame 18 with a dark-colored coating from Sarantos. *See id.* at 9, 21. Apple then identified the optical filter 17, which is a physical structure “mounted

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



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

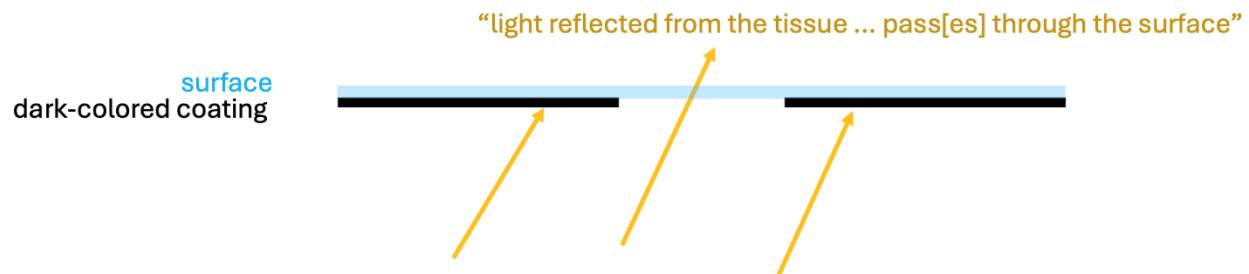
62. However, as Iwamiya confirms, the optical filter 17 is a solid material that is mounted on the light shielding frame. EX1004, 8:39–42. As Apple’s expert stated, “A POSITA would not regard solid material as an ‘opening.’” EX2037, ¶465. Moreover, he emphasized that “[m]aterial, such as closed windows and solid lenses, are the opposite of an ‘opening’” and that “[s]tretching the claim term ‘opening’ to encompass a closed window as an equivalent would vitiate the requirement of an ‘opening.’” *Id.* at ¶479. Thus, under the claim construction Apple is proposing in Delaware, the Iwamiya-Sarantos combination cannot demonstrate the obviousness of Claims 1 and 19.

2. **The Iwamiya-Sarantos Combination Does Not Have an “Opening Defined in the Dark-Colored Coating” that Allows Light to “Pass Through the Surface”**

63. Although I do not agree with Apple’s Delaware claim construction of “opening,” the Iwamiya-Sarantos combination still does not disclose an opening configured to allow light to “pass through the surface.” That is true under any construction of the limitation. Specifically, Apple’s invalidity theory identified Iwamiya’s light shielding frame 18 as the recited “surface.” *See* Petition, 21 (“[T]he Iwamiya-Sarantos combination includes a ‘light shielding frame 18’ (the claimed ‘surface’) surrounding the photo diodes/light receiving units 9...”). However, in the Iwamiya-Sarantos combination, light does not pass through the light shielding frame 18 and thus does not “pass through the surface.”

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

where the optical filter is located. Under the plain meaning of the claim language, light must “pass through the surface”—in other words, through the light shielding frame, for example as shown below.



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

Because light does not pass through the light shielding frame through any opening, the Iwamiya-Sarantos combination does not disclose [1.4], [1.5], and [19.5].

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

65. Even if Apple’s proposed Iwamiya-Sarantos combination satisfied limitation [1.4], [1.5], and [19.5], which it does not under both Apple’s and Masimo’s positions, a POSITA would not have been motivated to make the combination. Apple presents the same motivations to combine Iwamiya with Sarantos that it previously presented in IPR2022-01291, IPR2022-01465, and also in the ITC investigation. I have reviewed the Board’s public final written decisions in IPR2022-01291 and IPR2022-01465. Although the Board found a motivation to combine Iwamiya and

Sarantos in those decisions, I respectfully disagree with the Board's previous decisions for the reasons I explain below.

66. First, the parties appear to agree that Iwamiya does not disclose a “surface comprising a dark-colored coating.” *See* Petition, 11 (“Iwamiya is silent as to the material or coating used to implement the light shielding frame 18....”). Indeed, based on my review of Iwamiya, there is no disclosure of a dark-colored coating. *See generally* EX1004. Instead, for this limitation, Apple argued that a POSITA would have added a dark-colored coating from Sarantos onto the light shielding frame 18 in Iwamiya. *See* Petition, 7–13, 21–23 (describing how Iwamiya's light shielding frame would be coated with an in-mold label from Sarantos). Apple argues that a POSITA would have added a dark-colored coating to the light shielding frame to block light. Petition, 9 (arguing the combination would “improve[] characteristics for shielding the photodiodes from stray light,” “limit[] reflections” and “block light”).

67. However, a POSITA would have understood from Iwamiya's description that the light shielding frame 18 is already made of a light shielding material. *See* EX1004, 8:38-47 (describing the light shielding frame as surrounding the light receiving unit 9 and having an optical filter 17 mounted on its lower side). In other words, a POSITA would understand that the light shielding frame is opaque to light, because it is “light shielding.” Opaque materials include reflective materials,

white materials, or any other color materials, so long as light does not transmit through the material. In fact, a POSITA would understand that the only thing the light shielding frame 18 cannot be is translucent or transparent, because that would allow light to pass through and would not be considered “light shielding.” Given that a POSITA would have understood that the light shielding frame 18 is already opaque, the question for obviousness should be whether a POSITA would have been motivated to further add a layer of dark-colored coating to the already opaque light shielding frame 18. I believe a POSITA would not have had such a motivation because that would have been unnecessary and redundant.

68. I understand that in IPR2022-01291, the Board found a motivation to combine Iwamiya and Sarantos. I disagree and believe the Board focused on the wrong question for motivation to combine. There, the Board found that Iwamiya “provides no detail concerning the *structural* configuration of frame 18” and “simply identifies the frame as ‘a light shielding frame,’ which is a functional description apart from the word ‘frame.’” IPR2022-01291, FWD, 38 (emphasis in original). The Board then stated that “Iwamiya leaves it to a person of ordinary skill in the art to choose a material or structure to incorporate within frame 18 to shield light away from reaching light receiving unit 9 without passing through optical filter 17.” *Id.* The Board then concluded that “Apple’s reliance on Sarantos as disclosing a suitable light-shielding material or structure for use with Iwamiya’s frame 18 is invited by

Iwamiya's disclosure, rather than assuming a problem in Iwamiya that does not exist." *Id.*

69. I believe the Board's analysis was incorrect in IPR2022-01291 and would be incorrect if applied to the current Petition as well. Apple's obviousness theory is based on adding a dark-colored coating to the existing light shielding frame 18 in Iwamiya. *See* Petition, 23. As I explained above, a POSITA would have understood that Iwamiya's light shielding frame 18 is already opaque, even if Iwamiya leaves out the exact details of that opaque material. But given that a POSITA would have understood the light shielding frame 18 is already opaque, a POSITA would not have had a motivation to then further add a dark-colored coating from Sarantos to the frame. Such a modification would have been unnecessary and redundant. A POSITA would not have identified a need to perform such a modification. Moreover, Sarantos' in-mold label or mask (EX1005, 17:3-12) does not provide the structural material for the light shielding frame itself. As Sarantos described the in-mold label/mask, it is just a label that is applied to a structure.

70. The Board's decision in IPR2022-01291 also incorrectly concluded that "the fact that Sarantos's dark-colored coating is disposed within a translucent or transparent material ... does not negate Apple's motivation, because Iwamiya does not limit the material or structure to be used in light shielding frame 18." IPR2022-01291, FWD, 40. I disagree, because as I explained above, a POSITA would have

understood from Iwamiya’s disclosure that the light shielding frame 18 is opaque—it cannot be translucent or transparent like Sarantos’s window on which it applies a dark-colored coating. A POSITA would not have recognized any need to take Sarantos’s coating and apply it to Iwamiya’s light shielding frame because the frame is already opaque. Without using the ’159 Patent’s claim language as a guide, a POSITA would not have been motivated to make this modification.

71. I also note that under Apple’s construction of “opening” to mean “empty space,” a POSITA would not have looked to Sarantos for a dark-colored coating in the first place because Sarantos uses solid windows, not empty spaces. *See* EX1005, Fig. 22, 17:1–10.

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

73. For example, Apple argues that a “coated light shielding frame has improved characteristics for shielding the photodiodes from stray light, thereby minimizing the amount of light that reaches the photodiodes 9 from LEDs 6 *without first being reflected off the user’s skin.*” Petition, 9. However, a POSITA would

not have been motivated by this reasoning because it is **not** the function of the light shielding frame to minimize light that reaches the photodetector without first being reflected by the user’s tissue. Indeed, Apple itself argued that this is a totally separate function that is unrelated to the light shielding frame. Specifically, Apple argued that it is the purpose of a different structure in Iwamiya—the “reflection layers 13 and 15”—to “prevent light emitted from light emitting unit 6 from reaching the photodiodes ... without first reaching the tissue of the user’s wrist.” Petition, 25. In fact, Apple argued in a concurrently filed against the related ’743 Patent that the function of the reflection layers 13 and 15 would not inform a POSITA’s understanding about the light shielding frame 18 because it has a different function. Specifically, Apple argued:

Indeed, the function of reflection layers is generally different from light shielding frame 18, which is specifically designed to shield light from reaching the photodiodes 9. APPLE-1004, 8:38-42. Iwamiya even refers to frame 18 and reflecting layers, e.g., reflection layers 13 and 15, by different terminology, thereby ***underscoring differences in their respective functions.***

IPR2024-00241, Petition, 17. Thus, under Apple’s analysis, a POSITA would not have been motivated to add a dark-colored coating to the light shielding frame to minimize the light from the LEDs that reaches the photodetector without first being

reflected off the user's tissue because that is not the function of the light shielding frame.

74. Apple also argues that using a dark-colored coating on the light shielding frame would have been beneficial because it absorbs light, rather than reflecting light. Petition, 9, 11–12. Apple argues that a dark-colored coating “would have reduced the amount of arrant [sic] light that could reflect back from the empty space through the optical filer [sic] 17 to the photodiodes” and that a “POSITA would have sought to reduce these effects since any light that reflected back from the space surrounding frame 18 and through the optical filter 17 to the photodiodes would have different path lengths that could increase optical interference and reduce measurement accuracy.” Petition, 12. That is incorrect because (1) Apple and its expert cited no evidence that a POSITA would have recognized such a motivation, (2) Apple appears to have relied on the '159 Patent's specification to provide the motivation, and (3) Apple ignores that Iwamiya's sensor design causes reflections all throughout the sensor.

75. Regarding (1), Apple did not cite any evidence that demonstrates that reflections within a sensor cavity can cause pathlength variations as a potential source of error. Petition, 11–12. Apple relies on excerpts from Webster (EX1009), but those cited sections do not support Apple's theory. *See* Petition, 11–12 (citing EX1009,

69, 96–97)⁴. However, page 69 of Webster discusses light scattering *in blood*, not inside the empty space of a sensor cavity. EX1009, 69. That page explains “Multiple scattering increases the optical path length and therefore increases the absorbance.” *Id.* That is a separate and distinct issue from light reflecting inside an empty sensor cavity because there is no blood inside Iwamiya’s sensor cavity to further absorb the red and infrared light of interest. Pages 96–97 of Webster also do not support Apple’s theory. Those pages discuss “two types of optical interference that may cause problems for the photodiode.” EX1009, 96. Webster explains that “[t]he first is excessive ambient light” and “[t]he second source of interference is optical cross-talk” which “may occur when multiple probes are used in close proximity” and “light from one LED probe is sensed by the photodiode of another probe.” *Id.* Thus, Webster does not support Apple’s alleged motivation to reduce reflections due to a pathlength variation problem. Dr. Anthony’s declaration also does not cite any support for this theory. *See* EX1003, ¶¶36, 42. His declaration sets forth the same argument and the same citation to Webster that I discussed above. Dr. Anthony also includes an additional citation to Schulz (EX1032). *See* EX1003, ¶36 (citing

⁴ Apple’s citations to this exhibit were to the PDF page numbers, not the original page numbers. *See* Petition at 10 n.2. I also refer to the PDF page numbers in this paragraph.

EX1032, 1:65–2:16, 9:58–10:23). However, those sections of Schulz also discuss ambient light and emitted light bypassing the tissue. *See* EX1032, 1:65–2:16, 9:58–10:23. They do not discuss pathlength variations caused by reflections inside a sensor. Thus, Apple has identified no prior art that would have suggested to a POSITA to use a dark-colored coating to reduce pathlength variations caused by light reflecting inside a sensor.

76. Regarding (2), Apple apparently relied upon the '159 Patent's own disclosures to provide the alleged pathlength motivation. The '159 Patent taught the use of a dark-colored coating to prevent pathlength variations that might occur when light reflects back and forth between the sensor and the user's tissue. *See* EX1001, 8:54–9:7. It is these reflections that can cause accuracy problems because the light would have varying amounts of light absorption by the user's tissue based on the different pathlengths through the tissue. *Id.* Apple apparently relied on this pathlength disclosure from the '159 Patent, because it did not identify any other reference that disclosed the same problem and solution. I understand that would be improper hindsight reasoning, which cannot demonstrate obviousness. But Apple also apparently misapplied the '159 Patent's teachings to the empty space inside Iwamiya's cavity, where there is no tissue.

77. Regarding (3), Apple's alleged motivation to reduce reflections inside Iwamiya's sensor cavity does not make sense because if such reflections were

recognized as an issue, a POSITA would have disregarded Iwamiya entirely. Iwamiya's sensor design *relies* on light reflecting around inside the sensor. Specifically, Iwamiya uses a light guide 7 which is coated with reflection layers 13 and 15. As shown below, light from the emitters 6 reflect around within the light guide.

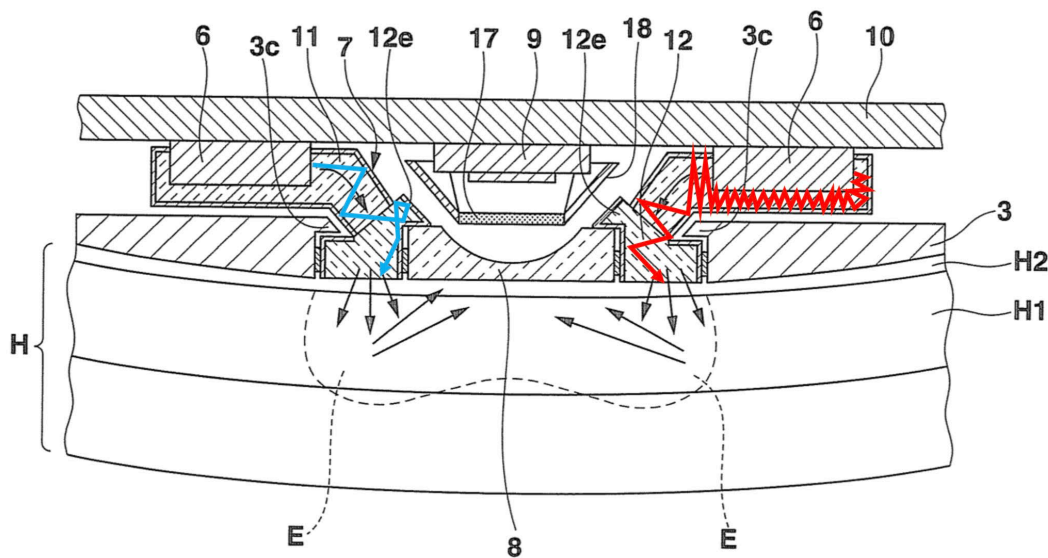


FIG.4

EX1004, Fig. 4 (annotated) (Note: Iwamiya's light guide is a 3D object, thus light would actually be reflecting around and scattering within the light guide in a more complex manner than illustrated in 2D above). As shown by the blue and red annotations, light reflects around the light guide in order to reach the user's tissue. Apple's suggestion that a POSITA would want to avoid reflections within a sensor is inconsistent with Iwamiya's design. A POSITA therefore would not have recognized

any motivation to add a dark-colored coating to the existing light shielding frame to address reflections.

78. Additionally, a POSITA would not have viewed reflections as a problem to be addressed when Iwamiya repeatedly taught the use of reflective materials to provide a light shielding function. Specifically, although Iwamiya does not describe the material of the light shielding frame 18 when describing the embodiment shown in Figures 1–4, Iwamiya describes the material of an analogous structure—the holder portion 43—that is described with respect to three other embodiments in Iwamiya. Iwamiya states “holder portion 43 of the light receiving unit 33 is formed of a metal with a *light shielding property*, such as aluminum, and its surface is subject to alumite treatment to have a *reflection function*.” EX1004, 18:61–65; *see also* 28:64–29:1 (same with respect to a third embodiment); 39:20–24 (same with respect to a fourth embodiment). A POSITA would have recognized that the holder portion 43 in those other embodiments is an analogous structure to the light shielding frame 18 in Iwamiya’s first embodiment because they perform the same purpose of holding the optical filter in place in front of the photodetector. *See, e.g.*, EX1004, Fig. 13, Fig. 16, Fig. 19, 18:51–60 (optical filter disposed in the holder portion), 28:52–63, 39:9–19. Indeed, Apple itself has referred to both the light shielding frame 18 and holder portion 43 together, further confirming that the structures are analogous. *See* Petition, 10 (“[A] POSITA would have known that a

light shielding frame 18 or holder portion 43 as disclosed by Iwamiya can be of various proportions, materials, and that a thin surface could be coated.”). In view of Iwamiya’s preference for using a reflective metal to provide the function of light shielding, a POSITA would not have viewed reflections within the sensor as an issue to be addressed.

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

80. Because a POSITA would have understood that Iwamiya’s light shielding frame 18 is already opaque to light, Apple’s argument is essentially that the frame *could* be coated with some dark-colored coating. But I understand that obviousness is not based on what *could* be done, but rather what a POSITA *would* have done. For at least the reasons I explained above, a POSITA would not have been motivated to further add a layer of dark-colored coating to Iwamiya’s light

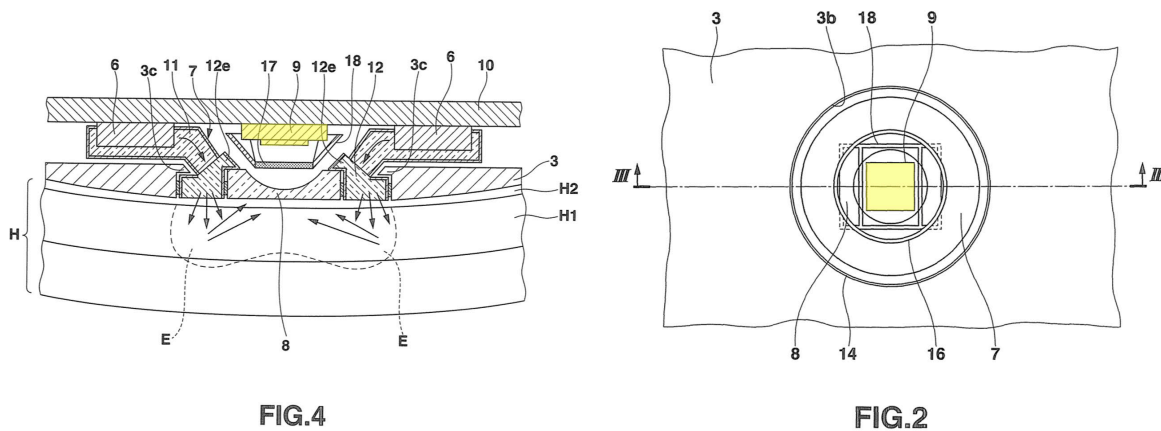
shielding frame. Accordingly, a POSITA would not have combined Iwamiya and Sarantos. Thus, Apple fails to demonstrate that Claims 1 and 19 and their dependent claims would have been obvious.

C. Claim 14 and Dependent Claims (Ground 1C)

81. Apple addresses Claim 14 in Ground 1C based on a combination of Iwamiya, Sarantos, and Utter. However, Apple fails to demonstrate that Iwamiya discloses or would have rendered obvious a “plurality of detectors are arranged in an array having a spatial configuration corresponding to a shape of the portion of the tissue measurement site bounded by the circular shaped light block” as recited in Limitation [14.4]. The argument for Limitation [14.4] in the Petition relies primarily on a cross-reference to the Claim 5 argument. *See* Petition, 62 (citing Petition, § [5.0]). Thus, I will address Apple’s arguments set forth there. Apple’s arguments regarding this limitation are similar to the arguments it presented in IPR2022-01291 with respect to a similar limitation in Claim 15 of the related ’745 Patent. I understand that the Board previously found a motivation to combine in the final written decision for IPR2022-01291. IPR2022-01291, FWD, 122–127. However, I respectfully disagree with the Board’s prior conclusion for the reasons set forth below.

82. Apple’s obviousness arguments rely on modifying Iwamiya’s first embodiment, which is illustrated in Iwamiya’s Figures 1–4. *See* Petition, 29–33

(discussing disclosures about Iwamiya's first embodiment and Figures 2–4 from Iwamiya); EX1004, 4:5–16 (explaining Figures 1-4 illustrate the same embodiment). However, Iwamiya does not depict a plurality of photodetectors in any of its figures of the first embodiment. Instead, Iwamiya's figures illustrate only a single photodetector (labeled as light receiving unit 9), as shown and highlighted yellow below:

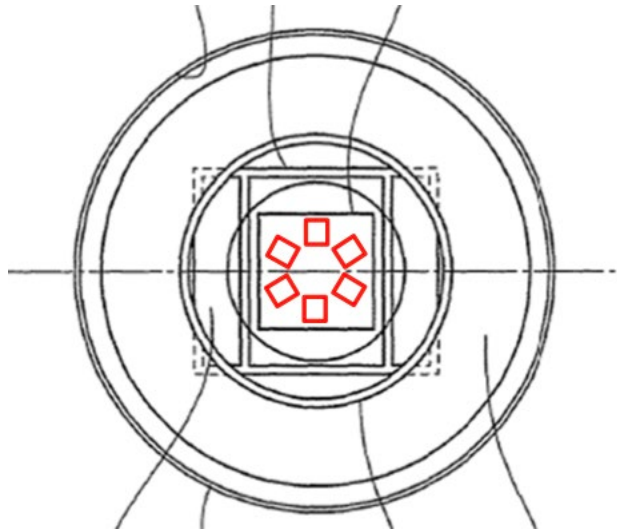


EX1004, Figs. 4, 2 (annotated).

83. Apple relies on a description in Iwamiya of an alternative embodiment where plural light receiving units 9 “may be two-dimensionally disposed in the places positioned at the side opposite to the skin H in the scattered light taking unit 8” and “the plural light receiving units 9 are preferably disposed on the same circumference centered on an optical axis of the scattered light taking unit 8.” Petition, 31–32 (citing EX1004, 14:36–41). However, as discussed above, Iwamiya does not illustrate that alternate embodiment or how the photodetectors would be arranged. Thus, the text

of Iwamiya does not demonstrate that there are a plurality of photodetectors arranged “in an array having a spatial configuration corresponding to a shape of the portion of the tissue measurement site bounded by the circular shaped light block” as required.

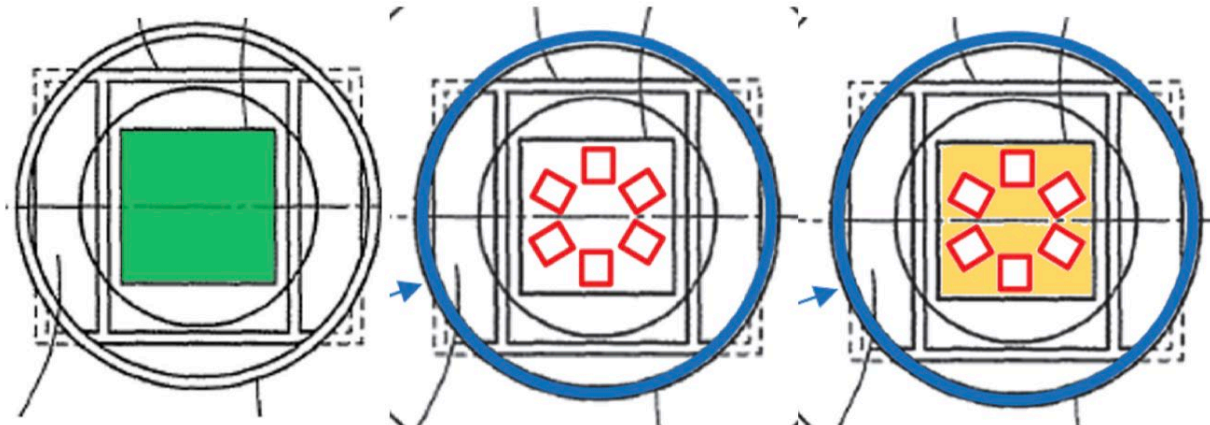
84. Apple and its expert argue instead that a POSITA would have understood from Iwamiya’s disclosure and would have found it obvious to arrange significantly smaller photodetectors in the following arrangement:



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

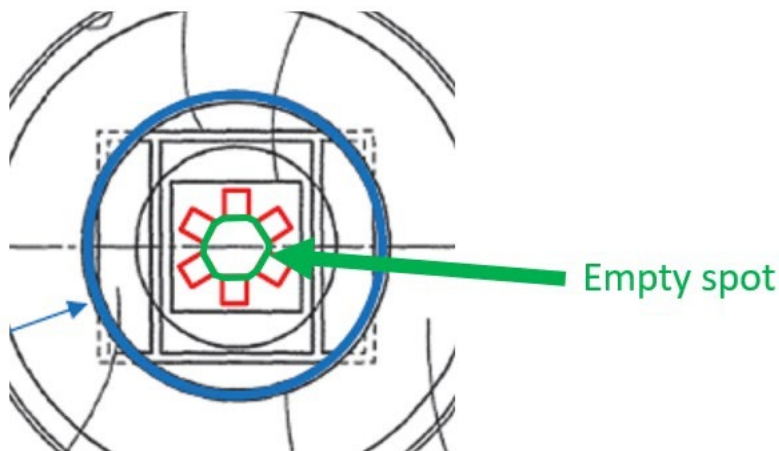
85. Apple argues that a POSITA would have been motivated to make this arrangement “to beneficially increase increase [sic] detection area and light sensitivity.” Petition, 34. But that is clearly incorrect. Apple’s proposed arrangement, which removes the original larger photodetector and replaces it with six significantly smaller photodetectors would only *decrease* detection area and light sensitivity. For example, as shown in the left image below, the original photodetector

9 is highlighted in green. Apple's proposed modification of Iwamiya to include six photodetectors (outlined red) is shown in the center image. The right image shows in yellow how much of the original photodetector coverage is lost by Apple's proposal.⁵



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

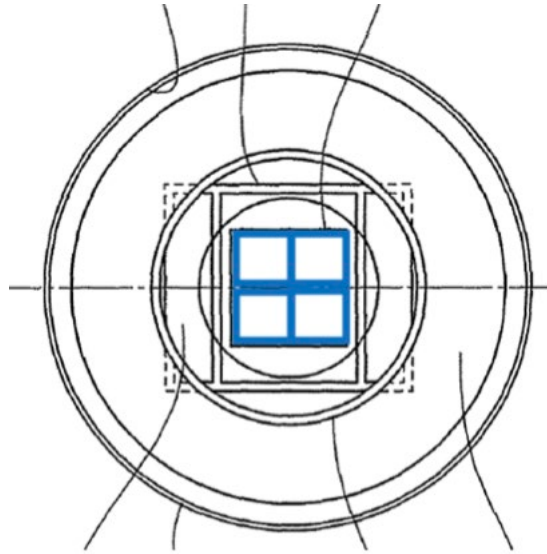
⁵ Where appropriate, I may reproduce figures and annotations from Dr. Duckworth's prior declarations in IPR2022-01291 and IPR2022-01465. I have reviewed the public versions of his declarations (EX2002, EX2070, and EX2100 in IPR2022-01291 and -01465) and his prior opinions are consistent with my opinions.



86. In Iwamiya’s sensor design, where light emitted on the periphery is directed towards a central light detector, it makes no sense to create a large empty spot by removing photodetector coverage, as Apple proposes. A POSITA would not have understood Iwamiya to propose such detrimental design. Such a design would be severely detrimental to sensor performance by reducing photodetector coverage. A POSITA would not recognize any benefit to be gained by Apple’s proposed modification, regardless of how many photodetectors there are, because Apple’s proposed modification reduces the photodetector coverage compared to the original larger photodetector.

87. Instead, a POSITA would have interpreted Iwamiya’s reference to light receiving units “disposed on the same circumference centered on an optical axis of the scattered light taking unit 8” to refer to the photodetectors’ relative location, not a circular array of detectors. A POSITA would have understood that Iwamiya described using a smaller plurality of photodetectors to cover the same area as the

original larger photodetector 9, for example, by using smaller square photodetectors in place of the single larger photodetector, as illustrated below:



EX1004, Fig. 2 (annotated, cropped).

88. I understand that the Board previously considered this argument when it was presented by Masimo’s prior expert, Dr. Duckworth. IPR2022-01291, FWD, 124. However, the Board dismissed the argument, stating “it is not clear to us why Dr. Duckworth thinks his four photodiodes are ‘disposed on the same circumference’ as stated in Iwamiya, yet at the same time they are not in a circular-shaped array as required by claim 15 [of the ’745 Patent].” *Id.* The illustrated arrangement above is not a circular-shaped array because it is a square shape. Just as the original photodetector 9 was a square, so to is the arrangement of four photodetectors that cover the same area as the original photodetector. In my opinion, the Board incorrectly dismissed Dr. Duckworth’s opinion (which I reiterated in this

declaration). Dr. Duckworth’s explanation provided the only reasonable interpretation of Iwamiya’s vague description of an alternate embodiment. A POSITA would not have interpreted Iwamiya’s description to suggest a circular array of photodetectors, regardless of the number of photodetectors, because such an interpretation would significantly reduce the photodetector coverage with no attendant benefit.

89. I also believe the Board incorrectly treated the claim limitation as reciting a numerical range, when no such range is recited. *See* IPR2022-01291, FWD, 124–126. The limitation reads, in relevant part, “plurality of detectors are arranged in an array having a spatial configuration corresponding to a shape of the portion of the tissue measurement site bounded by the circular shaped light block.” As explained above with respect to claim construction, Masimo disclaimed arrangements of two or three photodetectors during prosecution of a related application because those arrangements cannot form the required circular shape. EX2057, 322. However, a POSITA would not have understood Masimo’s disclaimer of those particular arrangements to have converted the claim limitation, which recites a particular structural arrangement, into a numerical range. I also believe that the Board incorrectly concluded that “Iwamiya itself contemplates using *plural* photodiodes 9 disposed in a circular array having its center located at the optical axis of the scattered light taking unit 8.” IPR2022-01291, FWD, 126 (original emphasis).

Iwamiya does not disclose any “circular array.” Iwamiya only contains the vague description of photodetectors “disposed on the same circumference centered on an optical axis of the scattered light taking unit 8.” EX1004, 14:39–41. But as I explained above, Dr. Duckworth’s interpretation of this language to show four photodetectors that cover the same area as the original photodetector was the most reasonable interpretation of the vague description in Iwamiya. A POSITA would not have interpreted the vague description to suggest a circular array, and certainly not Apple’s proposed circular array. Again, such an arrangement decreases the light detection area by creating a large empty spot at the center with no photodetector coverage. That is contrary to Iwamiya’s teaching that the photodetector should be located “in the vicinity of the focal position on an optical axis of the scattered light taking unit 8.” EX1004, 8:20–28. Because the “focal position” is on the optical axis, a POSITA would not have interpreted Iwamiya to suggest focusing the light received from the user’s tissue to a place where there is no photodetector coverage. That is an unreasonable interpretation. Thus, in my opinion, without looking at the ’159 Patent’s claim language, a POSITA would not have interpreted Iwamiya to disclose or suggest a circular array of photodetectors.

90. Thus, in my opinion, Apple has not demonstrated that Claim 14 would have been obvious.

91. 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. Thus, it is my opinion that none of Apple's grounds would render any of the challenged claims obvious.

IX. CONCLUSION

92. 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.