

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Ammar Al-Ali
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Title: PHYSIOLOGICAL MEASUREMENT DEVICES,
SYSTEMS, AND METHODS

SUPPLEMENTAL DECLARATION OF DR. BRIAN W. ANTHONY

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I, Brian W. Anthony, of Cambridge, MA, declare that:

I. INTRODUCTION

1. I have been retained by Fish & Richardson, P.C., on behalf of Apple Inc. (“**Petitioner**”), as an independent expert consultant in *inter partes* review (“**IPR**”) proceeding IPR2024-00241 before the United States Patent and Trademark Office (“**PTO**”). I understand that this declaration will be submitted in support of the Petitioner Reply to Patent Owner’s Response (“**POR**”) to the Petition for *inter partes* review of the ’743 Patent (U.S. Patent No. 10,687,743).

2. This declaration (“**Supplemental 743 Declaration**”) supplements, and is intended to be read in conjunction with, my earlier declaration in support of Apple’s Petition in IPR2024-00241. I will refer to my earlier declaration in IPR2024-00241 as the “**First 743 Declaration**” or “**APPLE-1003.**” In my First 743 Declaration, I address many topics, including (but not limited to) my background and qualifications, the level of skill in art, an overview of the ’743 Patent, claim construction, certain legal standards explained to me by Apple’s counsel, and a detailed analysis of the prior art against the ’743 Patent’s claims. The opinions and explanations expressed in my First 743 Declaration apply equally here.

3. In writing this 743 Supplemental Declaration, I have considered the following: my own knowledge and experience, including my teaching and work

experience in the above fields; and my experience of working with others involved in those fields. I have also reviewed at least the following materials, in addition to other materials I cite in this declaration:

- APPLE-1004: U.S. Pat. No. 8,670,819 (“Twamiya”)
- APPLE-1005: U.S. Pat. No. 9,392,946 (“Sarantos”)
- APPLE-1006: U.S. Pat. No. 8,446,275 (“Utter”)
- APPLE-1007: U.S. Pat. No. 6,483,976 (“Shie”)
- APPLE-1008: U.S. Pat. Pub. No. 2016/0058312 (“Han”)
- APPLE-1012: The American Heritage Dictionary of the English Language, 5th Ed., Houghton Mifflin Company, 2000, pg. 411-412
- APPLE-1013: Design of Pulse Oximeters, J.G. Webster; Institution of Physics Publishing, 1997 (“Webster”)
- APPLE-1014: Pang et al., A Neo-Reflective Wrist Pulse Oximeter, IEEE Access, Volume 2 (January 12, 2015)
- APPLE-1028: U.S. Pat. Pub. No. 2006/0253010 (“Brady”)
- APPLE-1032: U.S. Patent No. 6,580,086 (“Schulz”)
- APPLE-1033: U.S. Patent No. 7,468,036 (“Rulkov”)
- APPLE-1034: Li et al., A Wireless Reflectance Pulse Oximeter With Digital Baseline Control for Unfiltered Photoplethysmograms, IEEE

Transactions on Biomedical Circuits and Systems, Vol. 6, No. 3 (June 2012)

- APPLE-1035: Cai et al., Implementation of a Wireless Pulse Oximeter Based on Wrist Band Sensor, 3rd International Conference on Biomedical Engineering and Informatics
- APPLE-1036: Maattala et al., Optimum Place for Measuring Pulse Oximeter Signal in Wireless Sensor-Belt or Wrist-Band, 2007 International Conference on Convergence Information Technology
- APPLE-1037: U.S. Patent No. 5,164,858 (“Aguilera”)
- APPLE-1038: U.S. Pat. No. 5,830,137 (“Scharf”)
- APPLE-1039: U.S. Patent Application Publication No. 2005/0267346 (“Faber”)
- APPLE-1040: ITC Inv. No. 337-TA-1276 Exhibit RX-0508 (Jianchu Yao and Steve Warren, Stimulating Student Learning with a Novel “In-House” Pulse Oximeter Design (2005))
- APPLE-1041: U.S. Patent Application Publication No. 2014/0323829 (“LeBoeuf”)
- APPLE-1042: Fontaine et al., Reflectance-Based Pulse Oximeter for the Chest and Wrist, Worcester Polytechnic Institute (April 2013)
available at <https://digital.wpi.edu/show/6969z2326>

- APPLE-1044: International Publication No. WO 2011/051888
 (“Ackermans”)
- APPLE-1045: International Publication No. WO 2012/140559
 (“Shmueli”)
- APPLE-1046: U.S. Patent No. 7,650,176 (“Sarussi”)
- APPLE-1047: U.S. Patent Application Publication No. 2002/0095092
 (“Kondo”)
- APPLE-1048: U.S. Patent Application Publication No. 2015/0355604
 (“Fraser”)
- APPLE-1049: U.S. Patent No. 6,398,727 (“Bui”)
- APPLE-1080: CONFIDENTIAL - Transcript of the Deposition of Dr.
 R. James Duckworth (August 9, 2023)
- APPLE-1081: U.S. Patent Application Pub. No. 2010/0324387 to
 Moon et al. (“Moon”)
- APPLE-1082: CONFIDENTIAL - ITC Inv. No. 337-TA-1276
 Hearing Transcript of Dr. Saahil Mehra
- APPLE-1083: CONFIDENTIAL – Transcript of Testimony of Dr.
 Vivek Venugopal from June 6-10, 2022 Hearing Transcript, *Masimo
 Corp. et al. v. Apple Inc.*, ITC Inv. No 337-TA-1276

- APPLE-1084: CONFIDENTIAL - ITC Inv. No. 337-TA-1276
Hearing Transcript of Dr. Ueyn Block
- APPLE-1085: ITC Inv. No. 337-TA-1276 Exhibit RX-0498
(Takatani et al., Optical Oximetry Sensors for Whole Blood and
Tissue, IEEE Engineering in Medicine and Biology (June/July 1994))
- APPLE-1086: CONFIDENTIAL - Transcript of the Deposition of Dr.
Madisetti (February 4, 2025)
- APPLE-1087: CONFIDENTIAL - Transcript of the second session of
the Deposition of Dr. Vijay K. Madisetti (February 7, 2025)
- APPLE-1088: International Publication No. WO 2001/17421 to
Lindberg et al.
- APPLE-1089: U.S. Pat. No. 6,801,799 (“Mendelson”)
- APPLE-1090: Mendelson et al., A Wearable Reflectance Pulse
Oximeter for Remote Physiological Monitoring, Proceedings of the
28th IEEE EMBS Annual International Conference (Sept. 3, 2006)
- APPLE-1091: U.S. Patent Application Publication No. 2013/0267854
 (“Johnson”)
- APPLE-1092: U.S. Patent Application Publication No. 2005/0116820
 (“Goldreich”)

- APPLE-1093: Excerpt of Collins Dictionary, HarperCollins Publishers (2010)
- APPLE-1094: Excerpt of Merriam-Webster's Collegiate Dictionary, Eleventh Edition, Merriam-Webster, Incorporated (2014)
- APPLE-1095: The American Heritage College Dictionary (1993)

4. I have no financial interest in either party or in the outcome of this proceeding. I am being compensated for my work as an expert on an hourly basis, for all tasks involved. My compensation is not dependent on the outcome of these proceedings or on the content of my opinions.

II. TECHNICAL DISCUSSION

5. The analysis and opinions expressed in my first declarations fully explain why each and every feature of the '743 Patent's Challenged Claims is provided in the prior art. As I previously explained with reference to the applied prior art and corroborating references, the Challenged Claims would have been obvious to a POSITA. I understand that Patent Owner and Dr. Madisetti have considered my opinions and offered their own, some of which are inconsistent with my view. Below, I provide further testimony in response to Patent Owner's arguments. In responding to Patent Owner's arguments, I have analyzed various publications and materials including materials cited in my First 743 Declaration

and additional materials in this Supplemental 743 Declaration. The fact that I may not have addressed all of Patent Owner arguments and Dr. Madiseti's opinions should not be interpreted as agreement with them.

A. Iwamiya and The Iwamiya-Sarantos-Based Combinations Render Claims 1-25 of the '743 Patent Obvious

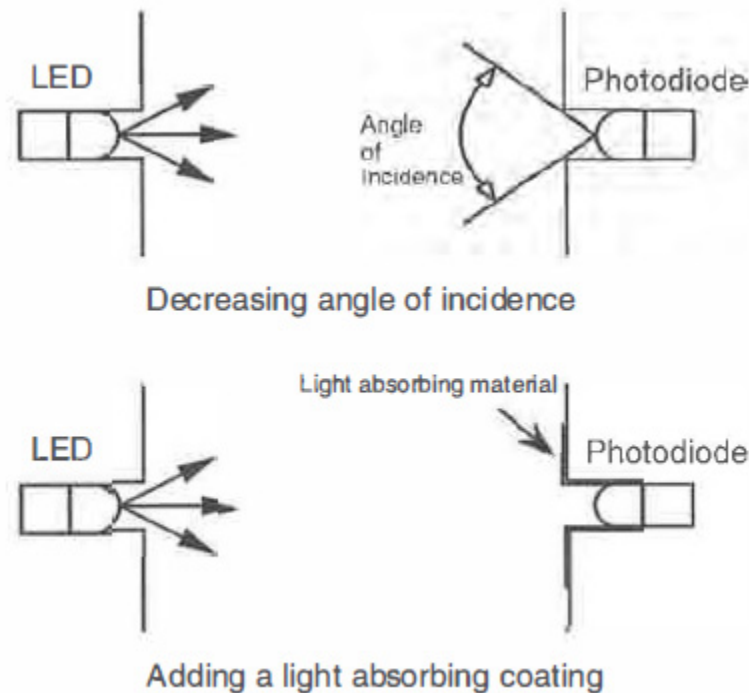
1. Iwamiya-Sarantos renders obvious a "surface comprising a dark-colored coating" (elements [1e] and [14e])

6. Patent Owner contends that the Iwamiya-Sarantos combination "ignored the teachings of Iwamiya" and that a POSITA would be required to use a reflective material to implement Iwamiya's light-shielding frame 18 because "[t]here is nothing in Iwamiya that teaches away from using the disclosed reflective material for the light shielding frame." POR, 12. I also acknowledge (and agree with) Patent Owner's assertion that "Iwamiya's light shielding frame 18 is itself made of a material that shields light." *Id.*, 14. However, as I discussed in my First 743 Declaration, while Iwamiya's original light shielding frame 18 was intended to block unwanted light from reaching the photodiodes, Iwamiya does not disclose a material or implementation for achieving the light blocking functionality of the light shielding frame 18. APPLE-1004, 8:38-42. The reflective material that Patent Owner insists *must* be used to implement the light shielding frame 18 comes from different embodiments of Iwamiya and is employed for different purposes than the light shielding frame 18. APPLE-1003, ¶¶51-53. Additionally, as I

discussed in my First 743 Declaration, a POSITA would have recognized that use of a dark-colored or black coating, as suggested by Sarantos, would have resulted in several predictable benefits over using reflective material. *Id.*, ¶¶45-53. Based on my review, a POSITA would have recognized that an opaque, light-absorbing material in the form of a dark-colored coating like that taught in Sarantos to be an obvious and well-known option for implementing the light shielding function of Iwamiya's frame 18. Indeed, the use of such a dark-colored coating was common practice well before the '743 Patent. APPLE-1005, 17:1-25.

7. For example, as corroborated by the Webster reference, a POSITA would have been aware that “[t]o minimize errors, the pulse oximeter designer must attempt to limit the light reaching the photodiode to that which has traveled through tissue containing arterial blood.” APPLE-1013, 96-97. A POSITA would have recognized that this would include not only preventing light from the light emitters of the device from reaching the photodiode prior to passing through the wearer's tissue (a function largely performed by reflection layers 13 and 15 in Iwamiya's device (APPLE-1004, 6:62-7:3, 7:41-49)), but also blocking of “ambient light” from the surrounding environment. *Id.* Webster further confirms the knowledge of a POSITA that preventing light that has not passed through the wearer's tissue from reaching the photodiodes is accomplished by placing a “[l]ight impervious barrier[]” around the photodiodes. *Id.* A POSITA would have

recognized that Iwamiya implements such a well-known light impervious barrier in the form of light shielding frame 18. Webster goes on to describe the knowledge of a POSITA that “[t]wo additional measures can be taken to ensure this (figure 6.6). One is to decrease the angle of incidence to the photodiode. The second is to *coat the housing around the photodiode with a material that does not scatter or reflect light.*” *Id.*, 96-97.



APPLE-1013, 97. In another example, Webster again confirms the knowledge of a POSITA to prevent ambient light interference using “the simple solution” of “cover[ing] the sensor site with opaque material.” *Id.*, 111. Therefore, Patent Owner’s assertion that the benefits that I discussed in my First 743 Declaration were based on the teachings of the ’743 patent itself could not be further from the

truth. A POSITA would have been well aware of the benefits of using a dark-colored coating to prevent scattering and reflection of light in an optical physiological sensor. APPLE-1013, 96-97.

8. As another corroborating example of the knowledge of a POSITA that it would have been obvious and beneficial to implement Iwamiya's light shielding frame 18 to include a dark-colored coating, as taught by Sarantos, to prevent unwanted light scattering and light paths, the Schulz patent discusses the knowledge of a POSITA that light shields in optical physiological sensors "are advantageously formed from or coated with a light absorbing material which further mitigates the effects of ambient light, as well as stray (i.e., 'secondary') reflected light with the probe generated by the light source 103." APPLE-1032, 9:58-10:23. As Schulz explains (and would have been known to a POSITA), "light generated by the light source 103 can take several paths in reaching the detector" but "only one" of these paths "is the desired path." *Id.* Schulz explains that "these other paths are eliminated or attenuated" through use of "light absorbing material" on the light shield "so as to substantially absorb any secondary reflections prior to being received by the detector 105." *Id.* As such, a POSITA would have understood that allowing light to reflect off the light shield would have increased noise and risked reducing sensor accuracy and that these undesirable outcomes

were beneficially reduced through use of a dark-colored coating for the light shield, as taught by Sarantos.

9. I disagree with Patent Owner's suggestion that a POSITA would be led by Iwamiya to select a reflective rather than absorptive material for use on the light-shielding frame 18. POR, 12-18. Based on my review, a Sarantos-like dark-colored coating would have been more effective than a reflective material at reducing light scatter in the empty space surrounding the frame 18, and this in turn would have been beneficial to reduce the amount of light that could reflect from the surfaces of the space through the optical filter 17 and the photodiodes. A POSITA would have sought to reduce these effects since any light that reflected from the surfaces surrounding 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. APPLE-1013, 69, 96-97; APPLE-1032, 1:65-2:16, 9:58-10:23.

10. I also disagree with Patent Owner's misinterpretation that Iwamiya specifically instructs a POSITA to use reflective rather than absorptive materials for light shielding. Patent Owner cites portions of Iwamiya that describe the use of reflective materials for components that are different and functionally distinct from the light-shielding frame 18. POR, 14-18. For example, Patent Owner refers to Iwamiya's description of holder portion 43 being reflective. However, the use of a

reflective material for implementing this unrelated structure in a different embodiment in Iwamiya would not have caused a POSITA to ignore the teachings of Sarantos or otherwise dissuaded the POSITA from implementing Sarantos's teachings regarding a dark-colored coating for blocking light in Iwamiya's device. For starters, Iwamiya's light shielding frame 18 and the holder portion 43 are not even used in the same embodiments. Iwamiya describes the "holder portion 43" with respect to "second," "third," and "fourth" embodiments. APPLE-1004, 18:61-65, 28:64-29:1, 39:20-24. These embodiments are substantially different from the "first embodiment" that uses light shielding frame 18, as shown below in the FIG. 3 first embodiment and the FIG. 13 second embodiment.

11. For example, the first embodiment with light shielding frame 18 includes a cavity or channel through which light reflected from the tissue may travel around a periphery of the frame 18 if it is not initially directed through optical filter 17. This cavity introduces greater risk of multiple scattering and pathlength variations not present in the embodiments that employ holder portion 43 (where no comparable cavity exists).

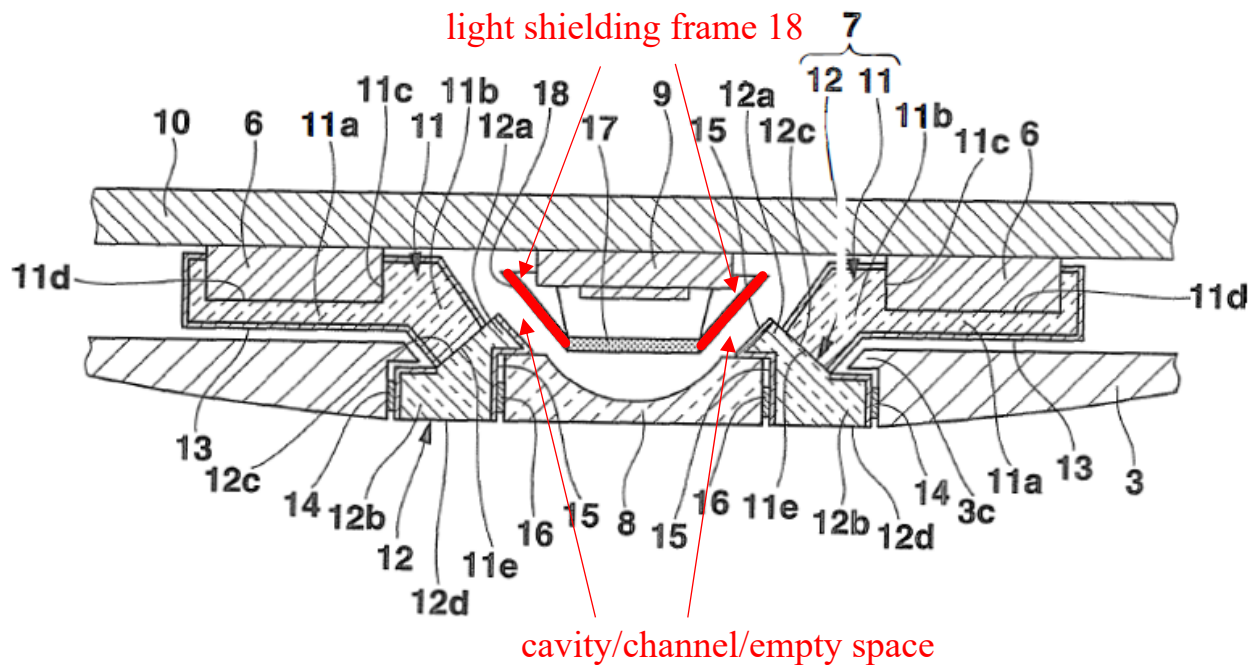


FIG. 3

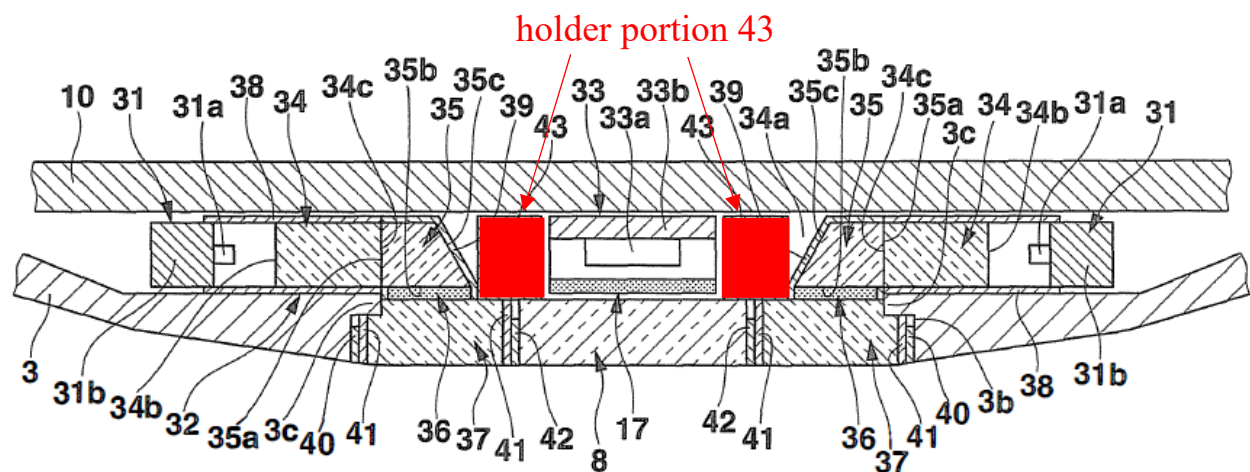


FIG. 13

APPLE-1004, FIGS. 3, 13 (annotated).

12. The geometrical aspects of components across various embodiments and diverse design considerations would have prompted a POSITA to make distinct choices for each component. Consider, for instance, the coatings on

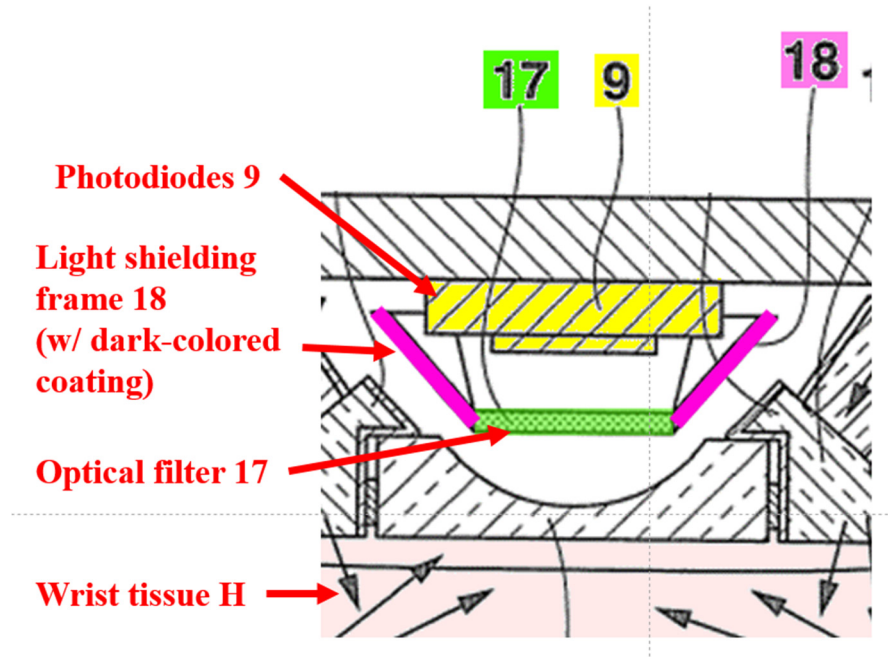
different sides of a structure. On one side, a coating can be light-blocking and reflective, while on the other side, a different coating could be light-blocking and absorptive. These design choices stem from the desired light trajectories and the intricate specifics of the system's overall configuration and geometry. In the case of the large obtuse angle geometry of the light shielding frame 18 of FIG. 3, using a reflective surface could potentially introduce multi-path artifacts more readily, in contrast to the arrangement in FIG. 13. In the embodiment shown in FIG. 13, employing a reflective light-blocking surface on holder portion 43 might enhance the signal as the specific geometry likely has a reduced risk of multi-pass or multi-path artifacts.

13. In contrast to Iwamiya's specific description of reflective materials for layers 13 and 15 and holder portion 43, Iwamiya leaves the choice of a suitable material for light shielding frame 18 to a POSITA. *Compare* APPLE-1004, 6:62-7:3, 7:41-49, 18:61-65, 28:64-29:1, 39:20-24 *with* APPLE-1004, 8:38-42. A POSITA would have found a dark-colored coating as taught in Sarantos to be an obvious and beneficial option for achieving the light-shielding function desired by Iwamiya, for the reasons previously discussed in my First 743 Declaration (APPLE-1003, ¶¶45-53) and this Supplemental 743 Declaration. Even if some other benefits might flow from use of a reflective material over a dark-colored coating in some cases, as alleged by Patent Owner, the mere existence of design

tradeoffs would not have detracted from the obviousness of using a dark-colored coating to shield external light from reaching the photodetectors.

2. Iwamiya-Sarantos (with or without Utter) Renders Obvious “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”

14. As I discussed in my First 743 Declaration, Iwamiya describes an optical filter positioned within an opening in the light-shielding frame. APPLE-1003, ¶¶67-72. As Iwamiya describes, the device includes “an optical filter 17” that “is mounted on the lower side of a light shielding frame 18” between the photodiodes 9 and the tissue H. APPLE-1004, 8:39-42. This configuration is shown in the following detail of FIG. 4 from Iwamiya:



APPLE-1004, Detail of FIG. 4 (annotated).

15. As I discussed in my First 743 Declaration (and in the previous section), a POSITA would have found it obvious and beneficial to apply Satantos's teachings to Iwamiya to coat the light shielding frame 18 with a dark-colored coating. APPLE-1005, 17:1-25; APPLE-1003, ¶¶67-73. As such, the opening in the center of Iwamiya's light shielding frame 18 is an opening defined in the dark-colored coating in the predictable Iwamiya-Sarantos combination. Iwamiya discloses that light passes through the optical filter 17 that is positioned within this opening in the light shielding frame 18 (which is also an opening in the dark-colored coating). APPLE-1004, 8:42-44.

16. Figure 4 of Iwamiya, reproduced with coloring and annotations above, represents a cross-sectional view of the sensor. APPLE-1004, 4:13-15. Figure 2 shows the sensor looking toward the sensor at the portion that contact's the user's skin.

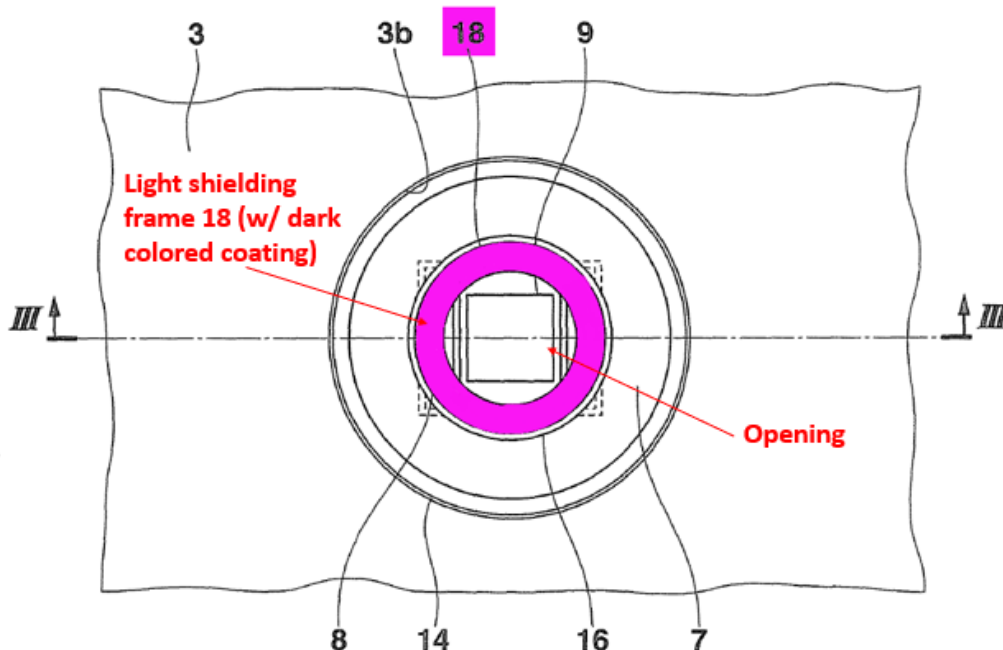
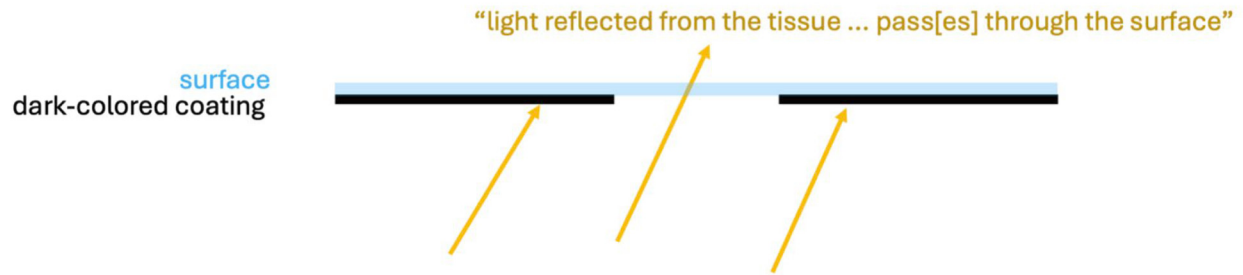


FIG.2

APPLE-1004, FIG. 2 (annotated).

17. As shown in from the perspective depicted in Figure 2, the light shielding frame 18 (colored pink), which is implemented to include Sarantos's dark colored coating in the predictable combination, "surround[s]" the light receiving units 9 and has an opening that allows light to pass through the surface. This opening in the light shielding frame 18 is an opening in the dark colored coating in the Iwamiya-Sarantos combination because the dark colored coating is applied to the surface of the light shielding frame 18 based on Sarantos's suggestion. As is apparent from Iwamiya's disclosure, the opening in the light shielding frame 18 and dark colored coating exists to allow light that has passed through the wearer's tissue to reach the sensor.

18. The Patent Owner's arguments in the 243-POR appear to assert that the claimed "opening" is required to include a transparent or translucent material. POR, 25. Patent Owner includes the following drawing in support of this argument:



POR, 25.

19. However, this drawing does not come from the figures of the '743 patent and is not based on the actual disclosures of the '743 patent. Rather, this drawing has been created by Patent Owner with no actual support in the '743 patent. A POSITA would not have understood elements [1E] and [14E] to require that the light pass into and exit from the material that defines the claimed "surface" but rather would have understood that the plain and ordinary meaning of these claim elements can be satisfied by the light passing through an opening in the material that defines the surface. For example, a POSITA would have understood that when water passes through a sieve or a piece of cloth, it flows through the openings rather than through the material itself. Yet, in this example, the water would be considered to pass through the surface of the sieve or piece of cloth.

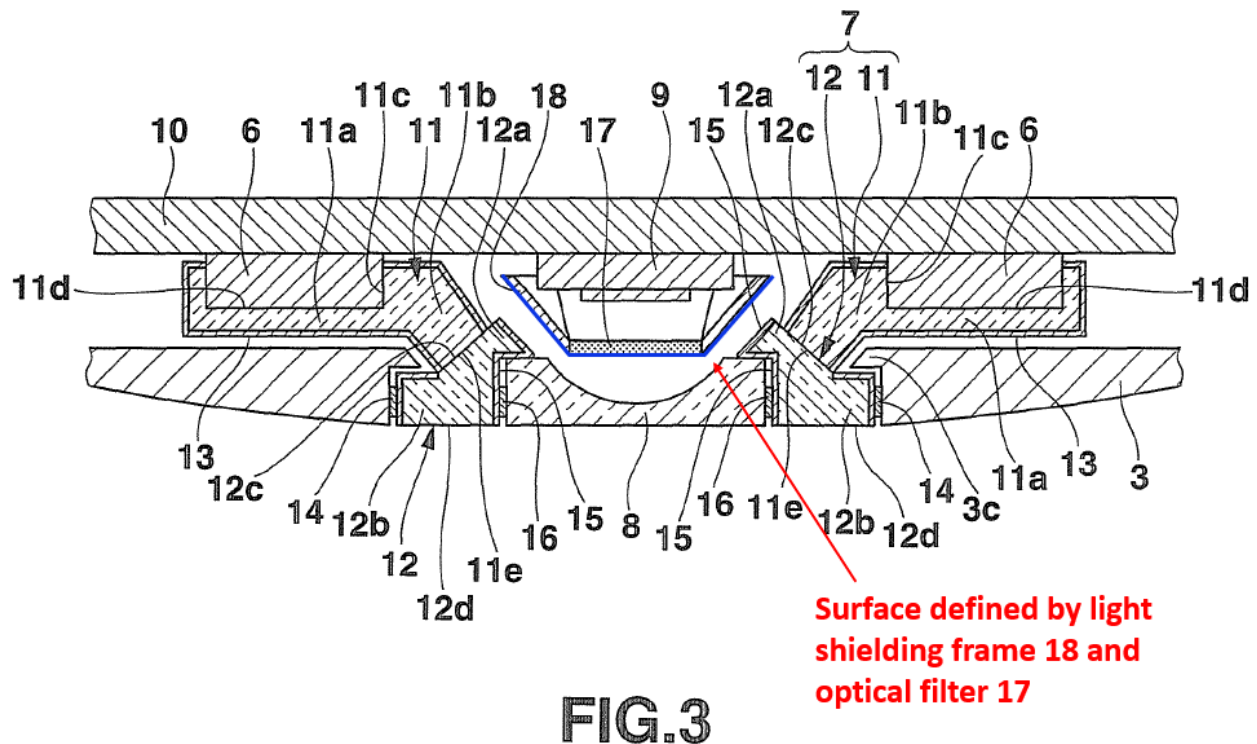
20. This proper assessment of the scope of elements [1e] and [14e] becomes even more clear when looking to how the specification of the '743 patent describes the opening in the dark-colored coating that allows light to pass through the surface. That is, all related descriptions in the '743 patent specification describe an opening free of material. There is not a single embodiment within the '743 Patent that describes the opening as including material with the light passing through a surface of that material. For example, one portion of the '743 patent describes a "light-absorbing detector filter" that is rectangular or square and "has an opening through which emitted light may pass." APPLE-1001, 3:64-4:14, 8:32-53. Notably, not only do these examples in the '743 patent not mention a material positioned within the "opening," they also do not mention a dark-colored coating.

Id. In another disclosure in the '743 patent specification, the '743 patent does describe that "[t]he light-absorbing detector filter 306 is illustrated having a top surface coated with a light-absorbing material. The light-absorbing material can be a black opaque material or coating or any other dark color or coating configured to absorb light." *Id.*, 9:31-36. This example goes on to describe "a rectangular opening 402 is positioned relative to the light concentrator 308 (shown in phantom) and the detector 310 such that light may pass through the rectangular opening 402, into the light concentrator 308, and to the detector 310." *Id.*, 9:36-40. In describing this embodiment, the '743 patent specification goes on to state that

“the patient’s finger servicing as the tissue measurement site 102 is positioned over the rectangular opening 402 such that when the front portion of the adhesive substrate is folded over on top of the patient’s finger 102, the emitter 302 and the light diffuser 304 are aligned with the measurement site 102, the filter 306, the light concentrator 308 and the detector 310.” *Id.*, 9:64-10:3. Once again, there is no description of material being positioned within the opening. This is the only example in the ’743 patent that discusses an opening in the dark-colored coating. As such, there is not a single example in the ’743 patent that even mentions including material within the opening, much less that requires that the light pass through a material in the opening. As such, there is simply no support for Patent Owner’s assertion that the opening must include a material nor that the light must enter into the material and exit from the material rather than simply passing through an opening in the material (the configuration actually described in the ’743 patent).

21. To the extent that elements [1e] and [14e] are improperly interpreted to require that the light enter and exit a portion of the material that defines the claimed surface, Iwamiya still provides these claim elements. As I discussed in my First 743 Declaration, Iwamiya describes an “an optical filter 17” that “is mounted on the lower side of a light shielding frame 18” between the photodiodes 9 and the tissue H within the opening of the dark-colored coating in the Iwamiya-Sarantos

combination. APPLE-1004, 8:39-42; 243-APPLE-1003, ¶¶71-72. As such, Iwamiya *does* describe a material within the opening in the dark-colored coating configured such that the light enters and exits the material. It is also apparent from Iwamiya's figures that Iwamiya's light shielding frame 18 and optical filter 17 together define a surface and therefore Iwamiya provides elements [1e] and [14e] even if it is incorrectly interpreted to require that the opening have material positioned therein (an interpretation not supported by the plain language of the claim or the specification, as I discussed above):



APPLE-1004, FIG. 3 (annotated).

3. **Iwamiya and Iwamiya-Sarantos (with or without Utter) render obvious that “the plurality of detectors are arranged in an array having a spatial configuration corresponding to a shape of a portion of the tissue measurement site bounded by the circular shaped light block” (element [22D] and claims 5 and 21)**

22. The First 743 Declaration demonstrated how claims 5 and 21 would have been obvious based on the teachings of Iwamiya-Sarantos and how element [22D] would have been obvious based on the teachings of Iwamiya, including Iwamiya’s disclosure that its monitoring device includes “**plural** light receiving units 9... two-dimensionally **disposed ... on the same circumference** centered on an optical axis of the scattered light taking unit 8.” APPLE-1004, 14:36-41 (emphasis added); APPLE-1003, ¶¶80-84. Iwamiya’s light block is circular, and the fact that Iwamiya’s plural photodiodes 9 are arranged in “a spatial configuration corresponding to a shape of the portion of the tissue [measurement site encircled/bounded] by the light block” is evident from the fact that the photodiodes 9 are arranged “on the same **circumference** centered on an optical axis” of the circular light taking unit 8. APPLE-1004, 14:36-41. The use of the word “circumference” would have immediately brought to the mind of a POSITA a circular arrangement for the plurality of light receiving units 9, angularly spaced around a circular center at some radial distance. As I previously discussed, based on the express disclosures of Iwamiya, including the description of the photodiodes 9 being arranged in a “circumference,” a POSITA would have understood and it

would have been obvious that the photodiodes 9 are thus arranged in an array where each photodiode is angularly spaced around a circular center, at some radial distance from and about the center, and having a spatial configuration corresponding to the circular shape of the tissue measurement site encircled by the circular light block, as illustrated below.

photodiodes 9 arranged “on the same circumference centered on an optical axis” of the circular light taking unit 8

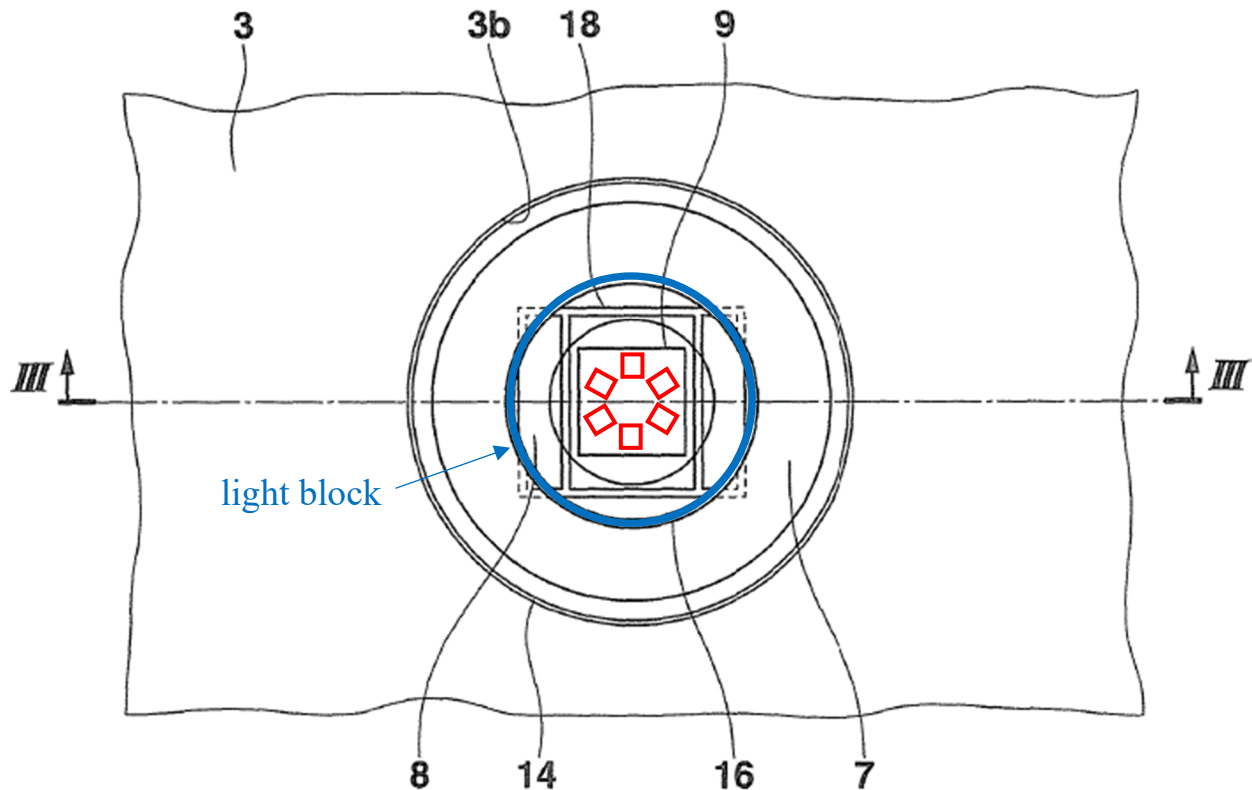


FIG.2

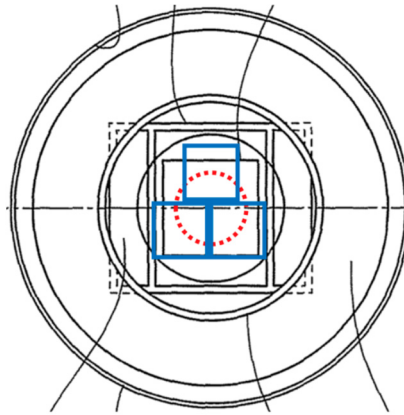
APPLE-1004, FIG. 2 (annotated according to Iwamiya’s teachings).

23. I find Patent Owner’s argument that Iwamiya provides only a “vague description of an alternate embodiment” having a plurality of light receiving units

9 to be problematic insofar as it seeks to hold Iwamiya to a higher standard of disclosure than the specification of the '743 patent itself. POR, 63. The '743 patent specification merely refers to a “plurality” of photodetectors 310/710, but never expressly discloses that any minimum number of photodetectors is required to form an array. *Cf.* APPLE-1001, 9:25-30, 11:37-43. Iwamiya substantially mirrors the '743 specification in disclosing “plural photodiodes 9” two-dimensionally arranged around a “circumference” of an optical axis. APPLE-1004, 14:36-41. To the extent a POSITA would have understood the disclosure of the '743 Patent as teaching more than a small number of photodetectors (e.g., at least six), a POSITA would have understood Iwamiya’s disclosure as encompassing the same. The '743 Patent describes no critical number or range of numbers of photodiodes required to achieve any particular performance standard or to achieve unexpected results. A POSITA would have found Iwamiya’s disclosure of a plurality of photodiodes sufficient to render obvious more than two or three (e.g., six or more) photodiodes in this context.

24. I also find Patent Owner’s arguments regarding proposed arrangements of three or four photodetectors 9 to be at odds with what a POSITA would have understood from the actual disclosures of Iwamiya. POR, 65-68. As I mentioned above, the use of the most logical inference that a POSITA would have drawn from the use of the term “circumference” by Iwamiya (rather than

describing the photodiodes as being in a square or triangular arrangement) is that the photodiodes were arranged in a circle about the circumference. While the proposed configurations for three or four photodiodes presented in the Patent Owner's Response may technically fall within the broadest possible interpretation of light receiving units 9 "disposed on the same circumference centered on an optical axis," they are not indicative of what would have readily come to mind to a POSITA upon reading of this disclosure of Iwamiya in the context of Iwamiya's broader disclosure as a whole. Rather, a POSITA would have read this disclosure of Iwamiya to represent what it actually says, a plurality of light receiving units 9 arranged in a circle about the same circumference. Additionally, Patent Owner's assertion that an arrangement of three photodetectors would form "a triangular array" is only true if one were to draw straight lines connecting the center points of the photodetectors. POR, 65-66. However, the actual language in Iwamiya, which describes the light-receiving units as being arranged "on the same circumference," implies a circular configuration of some radius. APPLE-1004, 14:36-41. When connecting the center points of the three light-receiving units using arcs of constant curvature, the resulting arrangement clearly forms a circular shape rather than a triangular one.



POR, 66. Patent Owner’s arguments on this point are also incorrect because they rely on an assumption that the light receiving units 9 must have a square shape.

There is no such limitation imparted by Iwamiya and thus a POSITA would have understood that Iwamiya discloses arranging the light receiving units 9 in a circle (thus corresponding to the shape of the portion of the tissue measurement site bounded by the light block) with the specific arrangement and configuration left up to the designer to select based on multiple design and manufacturing considerations for the entire system.

4. Iwamiya-Sarantos (with or without Utter and Han) renders obvious determining a physical parameter that is oxygen saturation (claims 11, 18, and 24)

(a) Sarantos discloses and renders obvious measuring oxygen saturation at the wrist

25. There is no dispute that Sarantos discloses that “photoplethysmographic techniques may also be used to measure other physiological parameters besides heart rate.” EX1005, 13:44-49. Sarantos clearly contemplates embodiments where its device would measure blood oxygenation

levels using red and infrared light. This is evident from Sarantos's express description of structural modifications that would be made to accommodate multiple LEDs of different wavelengths, including that "multiple light-emitting devices ... may[] ... be spaced apart from one another, as shown in FIGS. 1 and 2, or may be closely grouped." APPLE-1005, 13:34-36, 13:44-14:22. And although Sarantos notes that its disclosed "ratios and dimensional values" are "tailored based on the green/yellow light spectrum" rather than the "red or infrared spectra" (*see* APPLE-1005, 18:48-51), Sarantos does not criticize, discredit, or otherwise discourage investigation into the use of red/infrared light for measuring blood oxygen levels. To the contrary, Sarantos expressly discloses such embodiments. APPLE-1005, 13:44-14:22. Based on my review, Sarantos's description of green/yellow light (APPLE-1005, 18:48-51) merely indicates that Sarantos chose to illustrate its exemplary embodiments with respect to devices sensitive to green/yellow light rather than other spectra. A POSITA reviewing Sarantos's alternative embodiments for measuring blood oxygen levels (APPLE-1005, 13:36-14:22) would have understood and found obvious that the ratios and dimensions of Sarantos's HAR photodetectors could and would be suitably adjusted to optimize for the detection of red and infrared light as appropriate for measuring blood oxygen saturation levels.

26. Patent Owner now narrowly focuses on the use of the word “or” by Sarantos when describing use of red and infrared wavelengths for measuring blood oxygen saturation. POR, 30-31. First, these arguments by Patent Owner ignore that the term “or” is generally read to be inclusive unless specified otherwise, especially when being read by engineers, such as a POSITA in the relevant technology of the ’743 patent. Second, a POSITA would have understood Sarantos’s disclosure to be describing that to measure blood oxygen saturation, each individual LED (or other light emitting device) would have been implemented to “predominantly emit[] light in the red or infrared spectrum” such that in the resulting device the multiple LEDs would collectively emit red and infrared light and thus would have successfully measured blood oxygen saturation. APPLE-1005, 13:44-14:5. Indeed, Sarantos describes that each individual “light source 108 on the right side of FIG. 2 may be a red- or infrared-wavelength LED” to collectively provide light of both red and infrared wavelengths. *Id.* There is simply no support for the assertion that *all* light sources would be restricted to only red or only infrared wavelength LEDs in Sarantos’s blood oxygen saturation measurement implementation. This becomes even more clear when these disclosures of implementing each LED to emit “red or infrared” light are paired with Sarantos’s express disclosure of embodiments having “two light-emitting devices that predominantly emit light of different wavelengths.” APPLE-1005,

3:60-62. As I have discussed here, Sarantos later makes express what those two “different wavelengths” are in the blood oxygen saturation implementation: red and infrared wavelengths. APPLE-1005, 13:44-14:5.

27. Third, Patent Owner’s assertions that Sarantos’s blood oxygen saturation implementation utilizes light of *only* red or *only* infrared wavelengths ignores the well-established knowledge of a POSITA regarding which wavelengths of light to use in determining blood oxygen saturation. APPLE-1003, ¶¶89-93. For example, Webster confirms the knowledge of a POSITA that by 2015 it was well-known that “wavelengths of interest in pulse oximetry” are “660 nm and 940 nm.” APPLE-1013, 94-96. Brady similarly confirms the knowledge of a POSITA that optical sensors for pulse oximetry have light sources that “typically includes LEDs that generate both red ($\lambda \sim 660$ nm) and infrared ($\lambda \sim 900$ nm) radiation.” APPLE-1028, [0052]-[0054]¹. Indeed, Brady makes this corroborating disclosure in a wristwatch-based pulse oximeter that is highly similar to that of Sarantos. As such, a POSITA would not have been so confused by Sarantos’s use of the word

¹ Brady is Exhibit APPLE-1021 in the 244 Proceeding. I am using citation to the exhibit number (APPLE-1028) for Brady in this proceeding and throughout this Supplemental 743 Declaration. It should be understood that any citation to Exhibit APPLE-1028 also refers to Exhibit APPLE-1021 in the 244 Proceeding.

“or” to forget or ignore the wealth of decades of background knowledge on how to conduct pulse oximetry and which wavelengths of light to use to do so.

(b) A POSITA would have known how to make predictable adaptations to Iwamiya’s device that would allow the device in the Iwamiya-Sarantos combination to measure oxygen saturation

28. I understand that a showing of obviousness does not require a detailed explanation of every predictable structural modification that a POSITA would make to implement a proposed combination. Nonetheless, a POSITA would have known how to adapt Iwamiya’s device to measure oxygen saturation levels using red/infrared light as taught in Sarantos. Iwamiya’s device already includes 940 nm infrared LEDs that would be suitable for measuring blood oxygen levels; it would have been obvious and straightforward to augment the device with one or more LEDs emitting red light. *See, e.g.,* APPLE-1013, 94 (“The designer should keep in mind the wavelengths of interest in pulse oximetry (660 nm and 940 nm) when deciding on an appropriate photodiode”). For example, it would have been obvious and straightforward to add one or more red LEDs, as shown below.

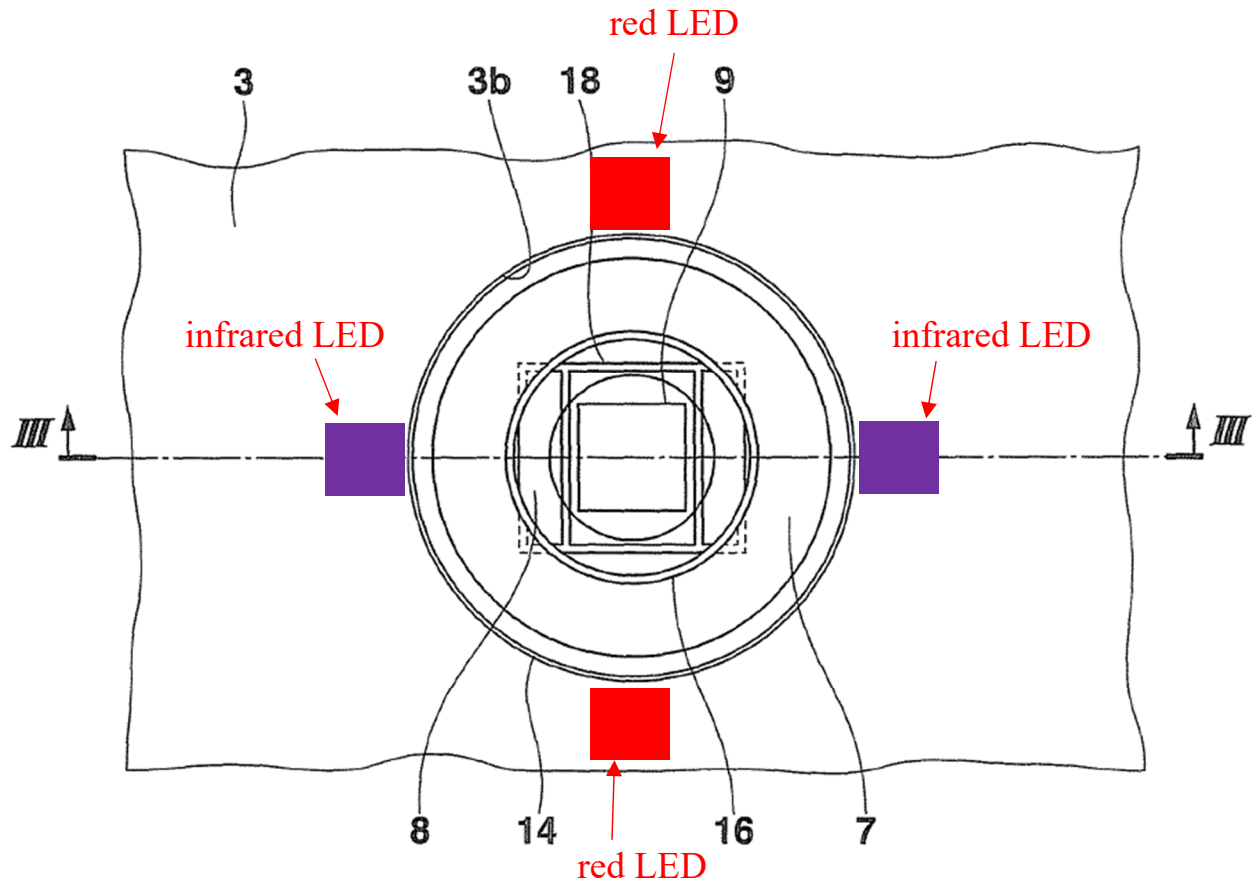


FIG.2

APPLE-1004, FIG. 2 (modified based on Sarantos's teachings).

29. As another example, it would have been obvious and straightforward to replace one of Iwamiya's original infrared LEDs with a red LED, as shown below.

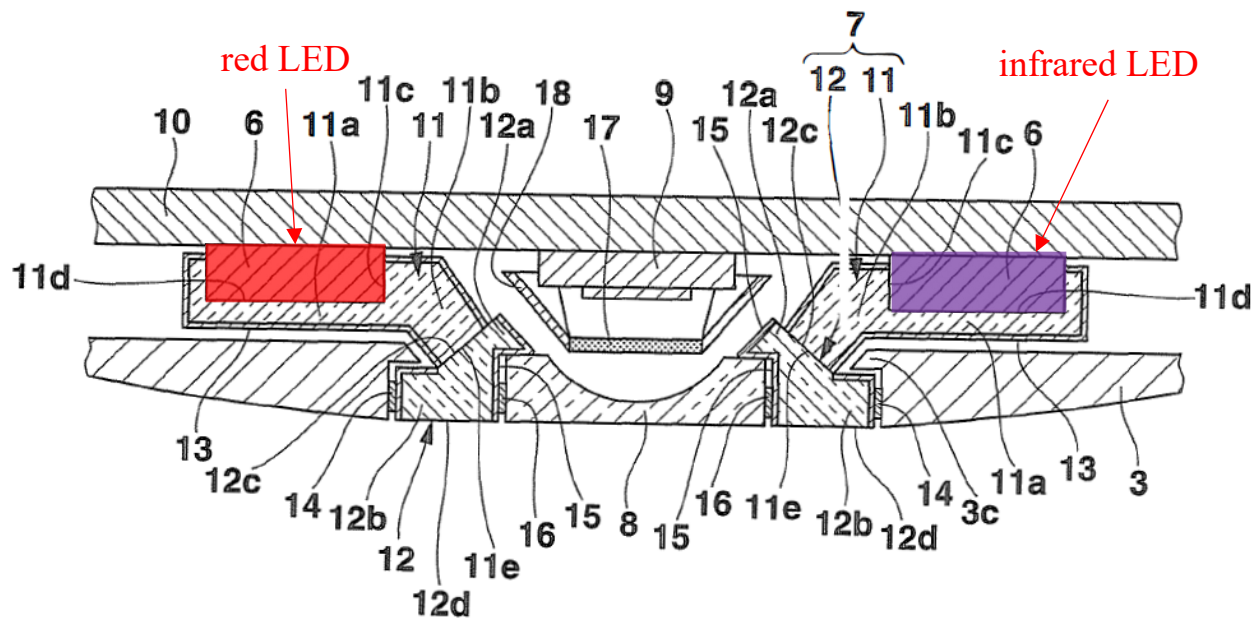


FIG.3

APPLE-1004, FIG. 3 (modified based on Sarantos's teachings).

30. As yet another example, it would have obvious and straightforward to replace Iwamiya's original infrared LEDs with a red LED and an infrared LED, as shown below.

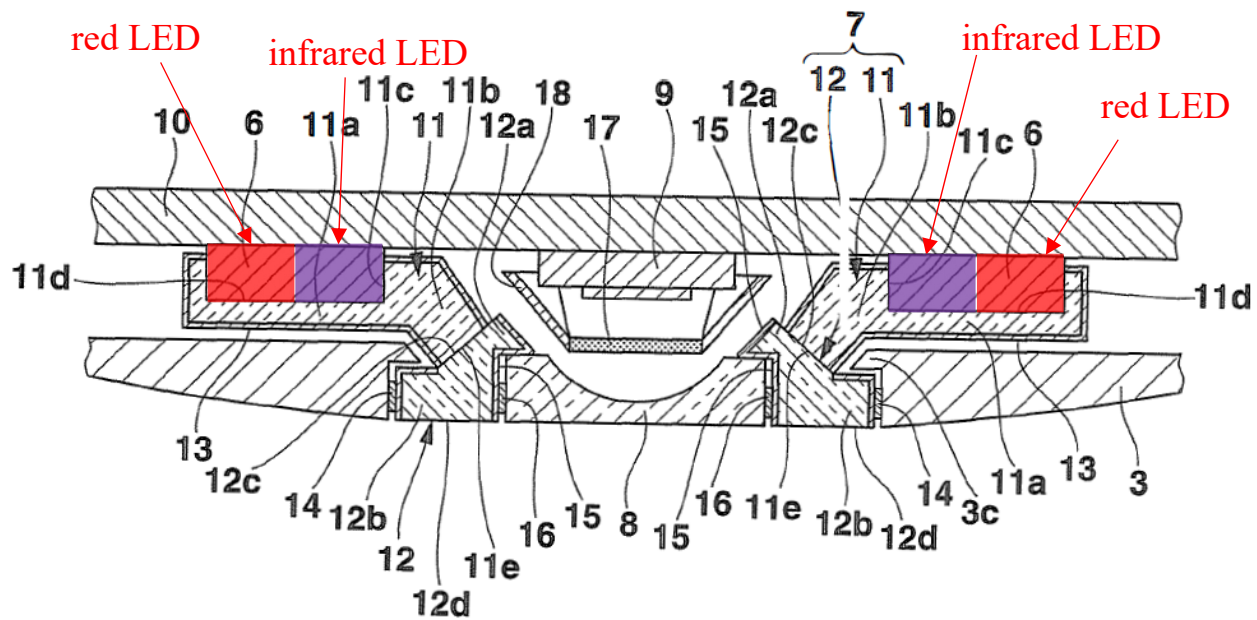


FIG. 3

APPLE-1004, FIG. 3 (modified based on Sarantos's teachings).

31. As I described in greater detail in my First 743 Declaration, a POSITA would have considered the specific placement of the red LED(s) relative to the infrared LED(s) to be a design choice and would have known how to, and would have found it obvious to optimize the sensitivity of the photodiodes, implement an optical filter that would pass both red and infrared light, and implement commonly known signal processing algorithms for calculating oxygen saturation from the detected light signals. APPLE-1003, ¶¶95-99.

(c) Patent Owner mischaracterizes Iwamiya in alleging that it teaches away from measuring blood oxygen saturation using red and infrared light

32. It is true that the main disclosures of Iwamiya focus on accurately detecting a pulse wave for measuring a pulse rate (heart rate), which can be accomplished using a single wavelength of light. Iwamiya thus describes using a **single** wavelength of infrared light at 940 nm, instead of a combination of infrared light with red light for measuring **a pulse wave**. APPLE-1004, 1:62-2:6, 6:32-35. But Iwamiya never criticizes, discredits, or otherwise discourages investigation into the use of **two** wavelengths (one in the red wavelength spectrum and one in the infrared light wavelength spectrum) for measuring **oxygen saturation**, and does not criticize, discredit, or otherwise discourage investigation into using an additional wavelength of light as required to make different measurements in different operating modes. A POSITA would have been aware that using two different wavelengths of light provides a second measurement signal, increases the overall accuracy, improves signal-to-noise ratio, and enhances the performance or functionality of the device.

33. A POSITA looking to implement Iwamiya to measure oxygen saturation would not have been led away from modifying Iwamiya's device to include red and infrared LEDs or from implementing any of the other obvious optimizations to Iwamiya's device as described in the preceding section for the

purpose of adding a capability to measure blood oxygen saturation. Indeed, a POSITA would have recognized that Iwamiya's 940 nm wavelength pulse rate measurements would still be retained in the device since 940 nm light is commonly used as one of the wavelengths for measuring oxygen saturation as well. APPLE-1013, 16, 52, 62-63, 73, 79-80; APPLE-1040, 4; APPLE-1042, 16; APPLE-1014, 1; APPLE-1091, 3-4; APPLE-1028, [0007]. Implementing Iwamiya in such a manner (based on the suggestions of Sarantos) would have retained the benefits of Iwamiya's original configuration with respect to measuring pulse rate of users with high melanin in the skin because it would retain the ability to measure pulse using 940 nm wavelength light. APPLE-1004, 1:62-2:6, 21:38-22:12, 10:34-38. By retaining the ability to measure the user's pulse using infrared light at 940 nm wavelength, "even though the epidermis H2 contains the large amount of melanine [sic] pigment, the observation light is light of an infrared band of $\lambda_p=940$ nm" in the resulting Iwamiya-Sarantos combination (or Iwamiya-Sarantos-Utter combination). *Id.*, 10:34-38.

34. Even if the application of Sarantos's suggestions regarding modifications for measuring blood oxygen saturation would cause Iwamiya to somehow perform slightly less efficiently with respect to determining pulse rate in users with high melanin content (it would not, as I discussed above), this would be merely a design consideration and trade-off and, at most, would apply only to users

having “a large amount of melanin[] pigment” and therefore the proposed modifications would be suitable for all other users having less than a “large amount” of melanin in their skin. APPLE-1004, 1:53–2:6, 6:31–34, 10:34–38, 11:43–49, 1:28-52. A POSITA’s desire to expand the capabilities of Iwamiya’s device by adding a red wavelength to measure oxygen saturation in addition to pulse rate would have justified any design tradeoffs necessary to implement oxygen saturation measurements.

(d) A POSITA would have been motivated to modify Iwamiya’s device to measure oxygen saturation at the wrist based on the suggestions of Sarantos

35. In my First 743 Declaration, I explained that a POSITA would have combined the teachings of Iwamiya and Sarantos to measure blood oxygen saturation to achieve known benefits such as improving the functionality and utility of the resulting device by expanding the range of physiological parameters measured by the resulting device. APPLE-1003, ¶¶89-93. Other reasons include (2) allowing people with cardiac or pulmonary disease to check their blood oxygen levels (including when jogging or exercising); (3) allowing pilots to determine if they need supplemental oxygen to thereby prevent dangerous flying situations; (4) providing alpinists with the ability to avoid injury or death by easily monitoring blood oxygen levels while climbing in high altitudes; (5) increased user satisfaction with such a device thereby increasing good will toward such a product

and increasing sales and brand recognition; (6) providing increased flexibility including the ability to monitor symptoms of decreased ability to ventilate such as cyanosis, dyspnea, tachypnea, decreased level of consciousness, increased work of breathing and loss of protective airway reflexes; and (7) allowing for monitoring of patients in different kinds of environments including moving of patients. Any one of these reasons would have motivated a POSITA to apply Sarantos's suggestions to Iwamiya's device and a POSITA would have recognized that the resulting device would have achieved all of these benefits and more.

36. I note that Dr. Madisetti's assertion that a POSITA would not have been able to implement the resulting device to "measure oxygen saturation at the wrist continuously through motion" is both incorrect and also, even if true, would not have detracted from the benefit of measuring blood oxygen saturation when exercising or jogging. EX2100, ¶86. For example, continuous measurements of oxygen saturation would be undesirable because the measuring device would consume power continuously and drain battery levels, resulting in a shortened device usage time. Rather, periodic or scheduled measurements may be used. Moreover, algorithms for correcting for motion artifacts when measuring blood oxygen saturation were well-known to a POSITA by 2015. For example, U.S. Patent Publication No. 2010/0324387 to Moon et al. ("Moon") (filed in 2009 and published in 2010) describes techniques for identifying and correcting for such

motion artifacts. For example, Moon describes various examples in which the system filters the PPG and PTT waveforms using detected motion of the patient to more accurately determine SpO₂. APPLE-1081, [0025], [0073]-[0074], [0089]-[0092]. Moon describes that “[t]he filter, for example, can be a matched filter, described in detail below.” *Id.*, [0025]. Moon goes on to describe that if “motion is determined to be present, the algorithm proceeds to analyze both RED/IR(PPG) waveforms to determine if they are distorted in any way.” *Id.*, [0073]. If “a pulse is corrupted by noise” due to movement, the system “deploys a ‘matched filter’ to process both the RED/IR(PPG) waveforms to maximize signal-to-noise ratios of the pulses therein.” APPLE-1081, [0089]. Such noise correction techniques would have been easily implemented, using software and simple motion detection hardware, to allow the resulting device to “determine accurate SpO₂ and cNIBP values even when motion-related noise is present.” *Id.* Moon provides a detailed description of how to correct for such motion induced noise. *Id.*, [0089]-[0092]. Moon’s motion correction techniques allow for “motion [to] be detected and accounted for during pulse oximetry measurements to minimize the occurrence of false alarms and, additionally, make accurate readings in the presence of motion.” *Id.*, [0082], [0089], [0102]-[0103]. However, all of this is really an aside because a POSITA also would have known that a person who is jogging or otherwise engaged in an exercise activity would be able to briefly pause their workout to

measure their blood oxygen saturation level using the device of Iwamiya-Sarantos without having to worry about motion artifacts. Additionally, as I described in my First 743 Declaration, and in the following section, a POSITA would have had a reasonable expectation of success in applying Sarantos's suggestions to Iwamiya's device to determine blood oxygen saturation at the wrist. APPLE-1003, ¶¶89-93.

(e) Sarantos enables measuring oxygen saturation at the wrist and a POSITA would have reasonably expected success in modifying Iwamiya to measure oxygen saturation at the wrist based on Sarantos's suggestions

37. As I stated in my First 743 Declaration, a "POSITA would have reasonably expected success in adapting Iwamiya's sensor" to measure oxygen saturation "because wrist-worn pulse oximetry sensors, such as that described in Sarantos, were well-known in the art." APPLE-1003, ¶¶90-93. I understand that Patent Owner attempts to refute my opinion in this regard, but based on my review of the record evidence, I believe Patent Owner's arguments that a POSITA would have lacked a reasonable expectation of success implementing a device that would determine oxygen saturation at the wrist are baseless. As I discussed in my First 743 Declaration, I reviewed over a dozen references that antedate the '743 patent and that underscore how determining oxygen saturation at the wrist was not only well known, but devices had been developed that successfully and repeatedly measured the physiological signals used to determine blood oxygen saturation

before the '743 patent. APPLE-1003, ¶93. These references reinforce and corroborate my original opinion from my First 743 Declaration that a POSITA would have reasonably expected success in adapting Iwamiya's sensor to measure oxygen saturation at the wrist.²

² In reviewing these references, a variety of wrist locations were proposed as suitable measurement sites for obtaining PPG signals useful for measuring blood oxygen levels of the user. Some references propose measuring from the outer portion of the wrist while others propose measuring from the inner portion of the wrist. Based on my review, measurements from both the inner and outer portions of the wrist would have been obvious and suitable in the prior art combinations. For example, Iwamiya's emitters/detectors are disposed on the back cover of a wristwatch case 1. APPLE-1004, 5:57-64, 9:61-63, FIG. 1. Sarantos includes a similar configuration. APPLE-1005, 7:12-23; FIGs. 2, 22. A POSITA would have known that the body of a wristwatch case can be worn to contact either the inner or outer portions of the wrist. Even if a user prefers to wear the wristwatch upwards on the outer portion of the wrist ordinary use in telling time, it would be a simple task to rotate the watch such that the back cover of the case would contact the inner portion of the wrist when the user desires to take an oxygen saturation measurement. Some of the references observed that a stronger signal could be

38. For example, Maattala identified an “optimum place” on a user’s “wrist so that it would provide reliable oxygen saturation (SpO₂) readings.” APPLE-1036, Abstract; APPLE-1003, ¶93. The results demonstrated that “wireless integrated pulse oximeter implanted in a ... wrist band is possible to achieve with many benefits and practical applications”:

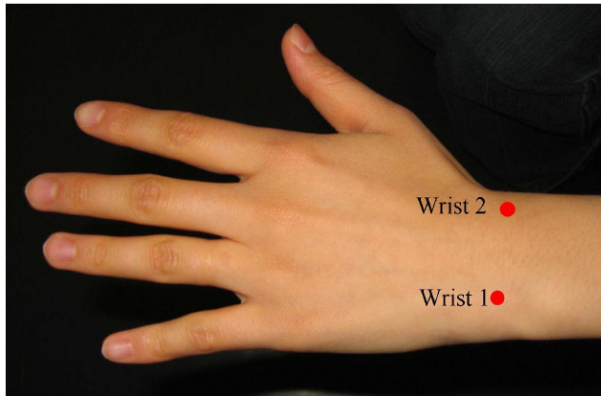


Figure 8. Measurement spots on the outer wrist

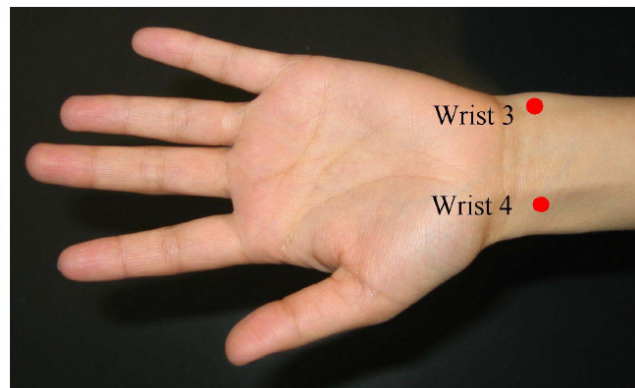


Figure 9. Measurement spots on the inner wrist

APPLE-1036, 3-5.

obtained from the inner wrist rather than the outer wrist where Apple sought to measure SpO₂ in the Watch. This further exemplifies how the experience of the Apple engineers in developing the Watch is not probative of reasonable expectation of success with respect to the claims of the '743 patent, which do not require measuring from the outer wrist.

39. In Cai, the authors “confirmed the feasibility of our oximeter” that employed “[a] wrist located reflectance sensor.” APPLE-1035, 1-2, (“...effectively detect the change of oxygen saturation.”); APPLE-1003, ¶93.

40. Li describes a wearable pulse oximeter that “gather[ed] high integrity data at...wrist...locations from a group of 48 subjects.” APPLE-1034, Abstract. Li’s “experimental data from the wrist” confirmed “suitable PPGs” for measuring blood oxygenation at the wrist. *Id.*, 8; APPLE-1003, ¶93.

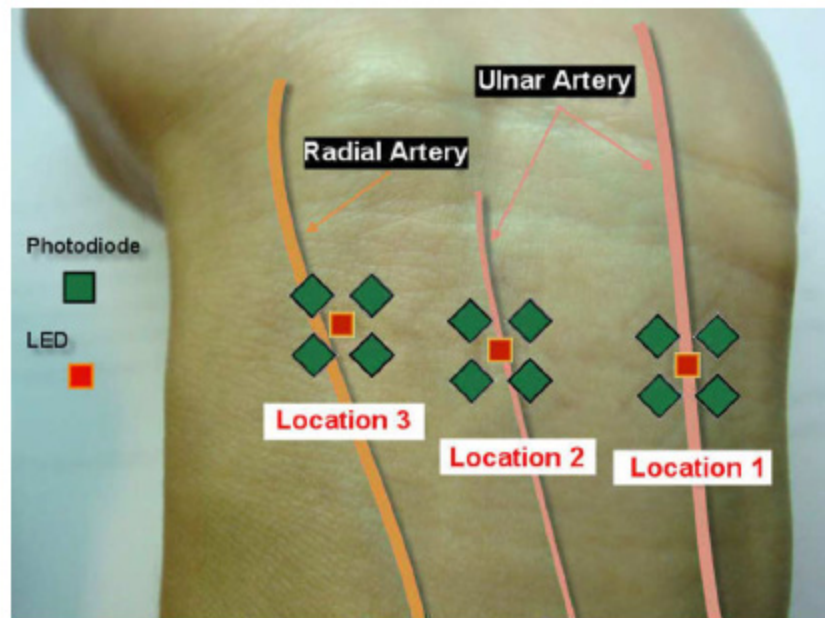


Fig. 14. Pulse oximeter measurement locations on the left wrist.

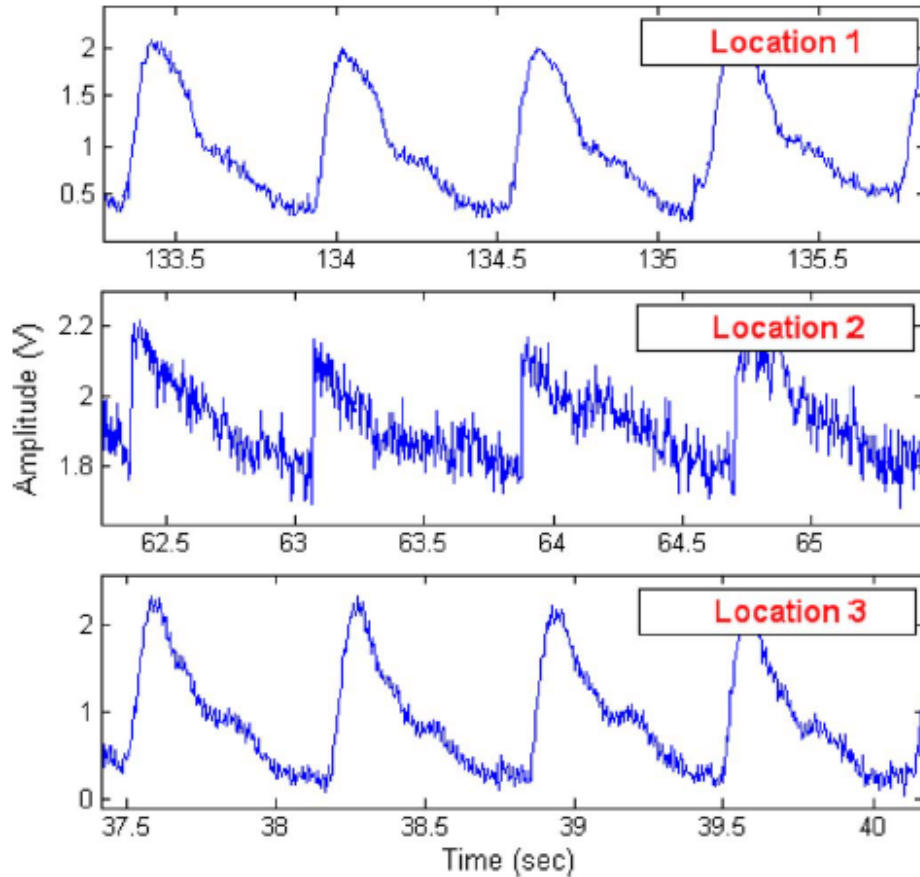


Fig. 13. Wrist PPGs corresponding to the placement locations in Fig. 14.

APPLE-1034, 8.

41. Notably, contrary to Patent Owner’s assertions (POR, 52), claims 11, 18, and 24 do not require any degree of consistency or “high quality PPG” signals and thus Li sufficiently demonstrates a reasonable expectation of success with respect to determining oxygen saturation to the degree required by the claims of the ’743 patent.

42. There are also several other references that that corroborate the reasonable expectation of success in combining the teachings of Iwamiya and Sarantos. Each of these references demonstrates that detection of the physiological

signals at the wrist used for determining blood oxygen saturation was successfully conducted prior to the '743 patent. *Id.*

43. For example, Pang describes a “wrist pulse oximeter... that can measure the pulse rate and oxygen saturation level in a person’s blood.” APPLE-1014, 1. Pang’s device “*detected the pulse wave signal efficiently*” (confirmed by “experimental results”) such that “*oxygen saturation can then be calculated.*” *Id.*, 5.

44. Further corroborating Li’s disclosure, Fontaine demonstrates that in 2013, a group of undergraduates were able to accurately measure within an error of + 1% and $\pm 3\%$ for SpO₂ and PR [pulse rate] respectively from the wrist.” APPLE-1042, Abstract.

Table 7.1: Calculated accuracy for the average SpO₂ and PR for each data set

Average Measurements	Reference		Prototype		Percent Errors	
	SpO ₂ (%)	PR (bpm)	SpO ₂ (%)	PR (bpm)	SpO ₂	PR
Wrist Standing	97.9	92.6	97.3	92.8	0.6	0.2
Wrist Sitting	98.2	82.4	98.4	83.3	0.2	1.1
Chest Standing	98.1	96.7	98.5	96.5	0.4	0.1
Chest Sitting	97.8	83.8	98.1	83.9	0.3	0.1

APPLE-1042, 60-101.

45. Brady is a patent application filed in 2006 that describes a wrist-worn physiological sensor that can measure and track various physiological parameters and other measurable statistics of the wearer, including “calories burnt during a set time period, [] heart rate, *blood oxygenation levels*, distance traveled, target zones and optionally dynamic blood pressure.” APPLE-1028, [0046]-[0047], [0032]-[0033]. The heart rate and blood oxygenation level parameters are measured using an optical device. *Id.* [0033]. Brady describes various specific configurations for the optical sensor, including different combinations of wavelengths of light emitted

by its light emitters, that can be used to measure blood oxygen saturation. *Id.*, [0051]-[0054]. For example, in one configuration:

[T]he optical sensor 30 is a ***pulse oximetry device with a light source 135 that typically includes LEDs that generate both red ($\lambda \sim 660$ nm) and infrared ($\lambda \sim 900$ nm) radiation.*** As the heart pumps blood through the arteries ***in the wrist of the user***, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photodetector 130, which is typically a photodiode, detects transmission at the red and infrared wavelengths, and in response generates a radiation-induced signal.

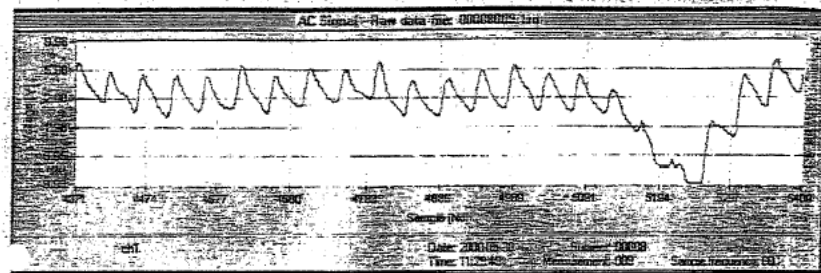
APPLE-1028, [0052].

46. Brady describes another example in which “the first light source 135 emits light in an infrared range ($\lambda \sim 900$ nm) and the second light source 135 a emits light in a red range ($\lambda \sim 630$ nm).” *Id.*, [0053]. In another example, “[t]he light source 135 typically is a light-emitting diode that emits light in a range from 570 nanometers to 1100 nanometers.” *Id.*, [0054]. A “flexible pulse oximetry board” calculates the blood oxygenation level based on the detected reflected light. *Id.*, [0058].

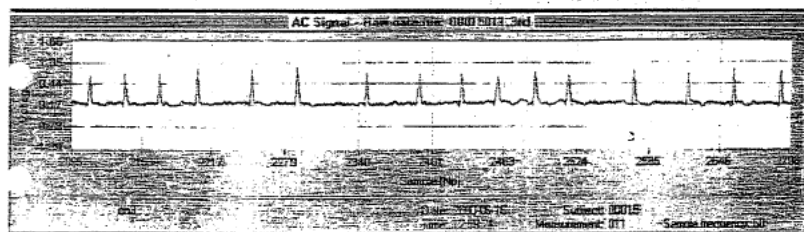
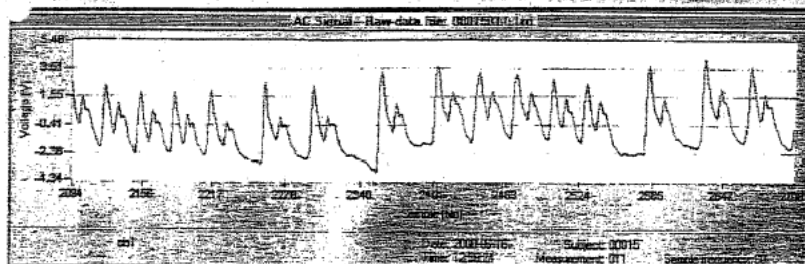
47. In another example, Lindberg describes an apparatus having “a patch which in turn is making part of a handcuff construction suitable for ***wrist measurements***...for determining ***blood characteristics*** including Hb and also

SpO₂.” APPLE-1088, 18. Lindberg specifically describes embodiments in which “[t]he PPG sensor was especially designed to be used on the wrist.” *Id.*, 49.

Lindberg describes various details on how to specifically blood oxygen saturation at the wrist, describing that “[f]or *SpO₂* determination, the above handcuff construction may preferably comprise two LEDs with wavelengths within the red and infrared range.” *Id.*, 49-50. This includes specific embodiments in which “only reflected light was detected, fastened on the wrist.” *Id.*, 52, 80-82. Figure 17 shows the successful measurement of PPG signals.



The PPG signal during blood dilution in the radial artery.



The PPG and ECG signals in a patient with arterial fibrillation.

APPLE-1088, 82.

48. In yet another example, Goldreich describes “a wrist-mounted device for measuring at least one physiological parameter of the user” such as “heart rate; regularity in heart rate; breathing rate; arrhythmia of the heart (if any), as well as the general rhythm and functioning of the heart; blood pressure; presence of abnormal body movements such as convulsions for example; body position; general body movements; body temperature; presence and level of sweat; **oxygen saturation in the blood**; and glucose levels in the blood.” APPLE-1092, [0035]-[0036], [0104]. For example, Goldreich describes measuring blood oxygen saturation using a sensor having “two light sources, optionally by two LEDs (light Emitting Diode) and a photoelectric detector for example. One of the LEDs emits in the infrared band and the other emits in the red band.” *Id.*, [0124].

49. The '743 patent specification does not identify any difficulties, differences in configuration, or problems associated with any of the measurement sites on the body, apart from the fact that some measurement sites would such as the finger and ear would ordinarily be measured with a transmittance-type sensor while other sites such as the wrist and forehead would ordinarily be measured with a reflectance-type sensor. The advantages disclosed by the '743 patent, such as an enlarged irradiating area, would not address the unique problems that Patent Owner now alleges would be required to overcome for wrist measurements apart

from other locations on the body. *See* APPLE-1001, 7:63-8:19, 8:20-9:10, 11:2-10, 11:44-53.

50. The '743 patent only mentions the wrist as a possible tissue measurement site in passing, with no acknowledgment of the alleged challenges of measuring at the wrist and no solutions specifically tailored to addressing the alleged challenges. For example, Dr. Duckworth, Patent Owner's expert in the IPR proceedings involving the related '745 patent, conceded that the forehead would provide a much stronger signal for measuring oxygen saturation than the wrist (APPLE-1080, 37:6-8), and yet the '745 patent/'743 patent specification discloses no sensor adaptations that would be employed to successfully measure a weaker signal at the wrist. The '743 Patent instead assumes that a POSITA would have known how to implement such measurements at the wrist despite the weaker signal. Patent Owner's expert in the related '745 patent proceedings agreed. APPLE-1080, 17:19-22, 29:2-31:17, 48:17-22.

51. Patent Owner's expert in the related '745 patent proceedings, Dr. Duckworth, was likewise unable to identify any specific feature or combination of features recited in the claims that allows for pulse oximetry at the wrist. APPLE-1080, 33:12-19, 37:9-38:7³, 39:9-45:22, 47:10-16, 49:1-15, 58:6-59:2, 83:20-84:4.

³ Dr. Duckworth identified FIG. 7A's "light concentrator 708," which does not

Indeed, the differences between claims 1, 14, and 22 show that certain features, e.g., a specific spatial configuration of detectors (element [14c], [22d]), are not required for measuring oxygen saturation at the wrist at least because these features do not appear in every independent claim. Notably, in the '743 patent, only claim 14 recites the word “wrist,” and that to in the context that light is emitted in pattern that is “proximate a wrist.” The '743 patent claims, therefore, are not even limited to obtaining measurements at the wrist. To the extent a POSITA would have understood the disclosure of the '743 Patent as teaching oxygen saturation measurements at the wrist, a POSITA would have also understood that level of skill is sufficient to enable the prior art.

52. Patent Owner relies on testimony from Apple’s engineers in an earlier ITC proceeding involving the related '745 Patent (and others) for its assertions that “a POSITA would not have had a reasonable expectation of success in modifying Iwamiya to measure oxygen saturation at the wrist” and “a POSITA in 2015 would not have had a reasonable expectation of success in modifying Iwamiya or Sarantos to measure oxygen saturation at the wrist.” POR, 40, 50. However, the Apple’s engineers’ testimony regarding their subjective experiences developing pulse oximetry for the Apple Watch is entirely different from the issues of whether

correspond to any claimed feature.

Sarantos enables performing the basic, claimed function of determining an oxygen saturation parameter at the wrist and whether a POSITA would have reasonably expected success in modifying Iwamiya's device to perform the basic, claimed function of determining an oxygen saturation parameter at the wrist. Significantly, no record evidence indicates that the Apple engineers intended to speak from the perspective of a POSITA.

53. Patent Owner also fail to place the Apple engineers' testimony in its proper context, instead cherry-picking soundbites in support of a misleading narrative. Considered in its entirety, it is clear that the challenges confronting the engineers in developing the pulse oximetry feature for the Apple Watch was not

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

54. I understand that evaluating the reasonable expectation of success requires consideration of the appropriate scope of the patent's claimed invention. The '743 patent claims do not specify a required accuracy or quality of its oxygen saturation measurements. Patent Owner's reliance on evidence of Apple's own successes developing pulse oximetry for the Apple Watch is primarily directed to product design challenges that are not relevant to assessing reasonable expectation of success in a manner commensurate with the broad scope of the oxygen saturation feature actually claimed in the '743 patent. The broad scope of the claims covers a practical use of a rudimentary pulse oximetry function that does not require the same level of functionality provided in the Watch. For example, U.S. Patent No. 6,398,727 to Bui et al. teaches an alarm/alert system for a pulse oximeter where "[t]he resolution of the pulse oximeter 214 is preferably 1% oxygen saturation and the accuracy is expected to be +/- 3% oxygen saturation" and includes a broad range (e.g., 50-100%) for the Low and High SpO₂ limits that trigger the alarm/alert system. APPLE-1049, 15:9-11. As another example, the oxygen saturation parameter might not even need to be a measurement. It could simply be a binary indication of whether a signal sufficient for measuring oxygen saturation has been obtained or an indication that oxygen saturation above a defined level of range had been detected.

55. That the challenges in developing the Apple Watch stemmed primarily from constraints not imposed by the claims of the '743 Patent is apparent from portions of the engineers' ITC testimony not cited in the PORs. For example, Land testified that they had to "make a product that checked all the boxes of low power, fit in this tiny form factor, worked well across all the use cases" including "cases of low oxygen in the blood," [REDACTED] [REDACTED] "make sure that it was beautiful and compatible with the look and feel of what the ID studio was going for for the product vision." EX2076, 958:19-24, 963:19-964:1, 964:7-11, 965:15-22, 970:15-972:5. Land's testimony is reproduced below:

A. Yeah. Industrial design is an important part of the Apple product. It defines, not only the outside shape of the product, but the look and the feel, and the design language, the aesthetics.

So we not only had to make a product that checked all the boxes of low power, fit in this tiny form factor, worked well across all the use cases, but we also had to make sure that it was beautiful and compatible with the look and feel of what the ID studio was going for for the product vision.

EX2076, 958:19-24

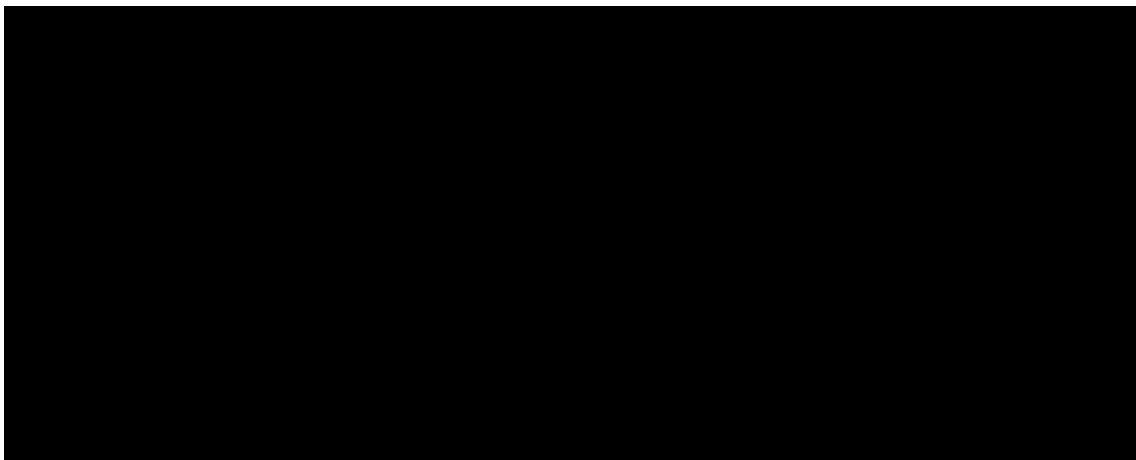
Q. What were some of the challenges that you and your team faced in developing the blood oxygen sensor for the Apple Watch?

A. The challenges were -- were many. The first was we had to fit into the small form factor of the watch and we were trying to hit a moving target, because every -- it seemed like as every year went by the watch got a little smaller.

And we also had to work across -- at the wrist, which was unprecedented -- at the time that we kicked off the blood oxygen sensing at the wrist, there were no commercially available products that did blood oxygen sensing at the wrist.

We also had to fit into a product that had very little space for the resources needed were accurate, and, of course, we had to work across all of the human variation that existed in the world. Those were some major challenges.

EX2076, 963:19-964:11



Can you give Her Honor just a few examples of other features and functions in the Series 6 beyond the features developed by your team?

A. Yes. There's audio, which can be used to listen to music or make a phone call, speaker microphone. There are motion sensors that can be used to track your motion, steps, your calories burnt through the day. There is a near-field communication sensor that you can use for a point-of-sale display.

There's all sorts of wireless connectivity, Bluetooth, Wi-Fi, including cellular networks for network connectivity, and that's one of the particularly challenging module that's in the Apple Watch, because there's a powerful transmitter that needs to talk with cell phone towers that are perhaps miles away, and that's a potential source of interference for all the sensors.

There's also other health sensors. There's an ECG sensor. There's a touchscreen. There's -- and it's really kind of a miniature computer in addition to all the sensors.

EX2076, 970:12-971:6

A. Yes. The list between Series 6 and Series 7 is quite similar. There's a few I didn't mention, like GPS, to tell you where you are on a map, there's a compass to give you a heading if you're walking through a map, et cetera.

Q. Now I think you touched on some of the challenges posed by all of these different components.

Can you tell us a bit more about the challenges of developing a blood oxygen sensor in light of all of the other components that we see on the specifications that we've gone through?

A. Yes. The Apple Watch is very compact. Everything is co-located in a very tight space. And every single one of these sensors and modules is run by electricity. It can be a source of interference, interference into the blood oxygen sensor.

And we had to, in addition to making an excellent blood oxygen sensor, we also had to consider all of these interference sources and design the integration of the blood oxygen sensor into the watch in a way that avoided these interference sources and worked under the use cases that we care about.

EX2076, 971:10-972:5

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]



EX1083, 832:23-833:10.

57. Block testified that “trying to figure out how to take [the blood oxygen feature] and integrate it into a very complicated, very small consumer electronic device was extremely difficult.”

Q. What are you most proud of with respect to your work on the blood oxygen feature in Apple Watch?

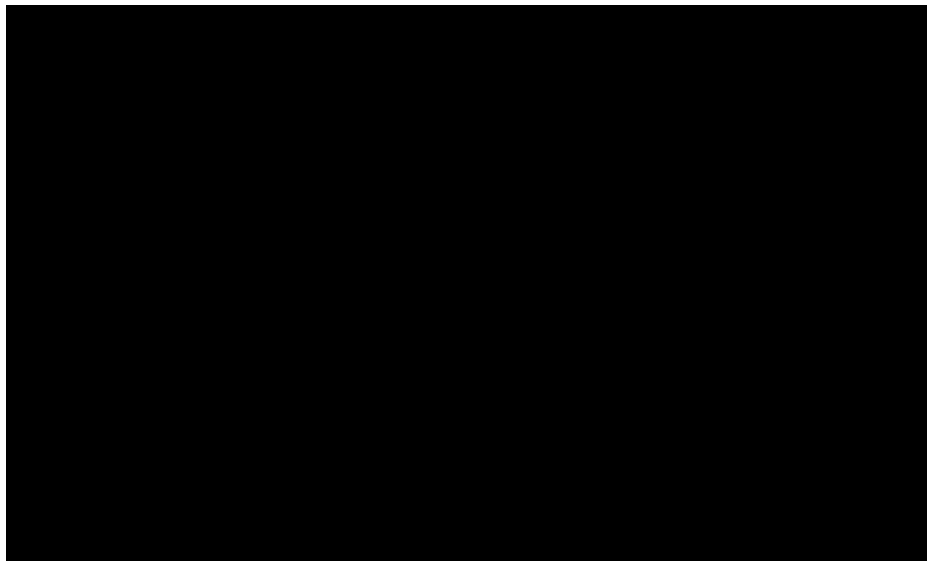
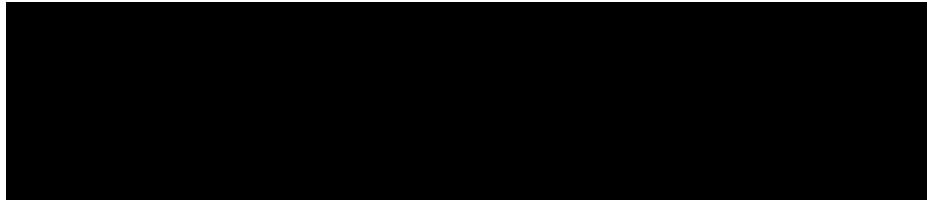
A. It was definitely very hard work to figure out how to make it work on the wrist, but, beyond that, just trying to figure out how to take that and integrate it into a very complicated, very small consumer electronic device was extremely difficult.

EX1084, 902:13-19.

58. Shui explained that the “ challenging part of the work is related to the position of the Apple Watch blood oxygen sensor” within the Apple Watch where 



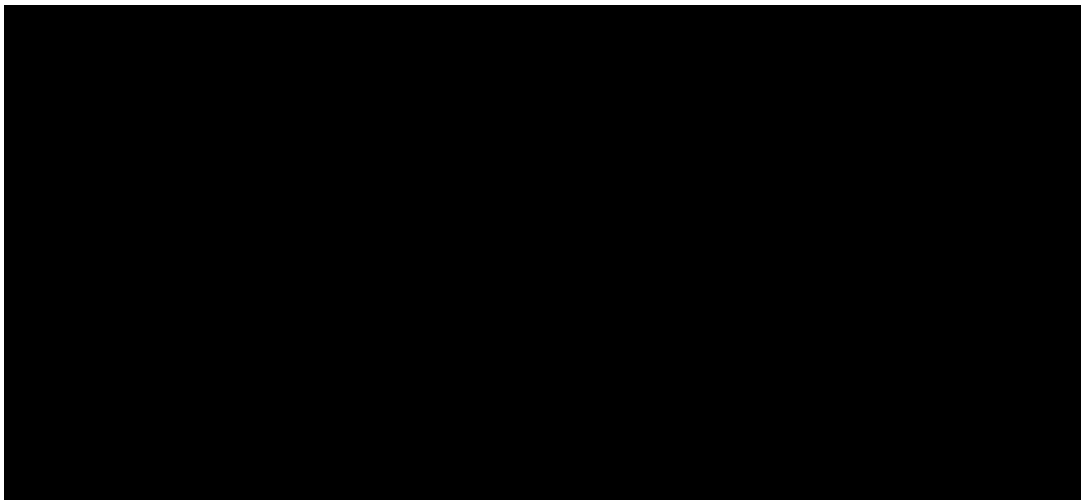
A. The most challenging part of the work is related to the position of the Apple Watch blood oxygen sensor. The watch is worn on the wrist, and the wrist is well known for its lack of signal.



[REDACTED]

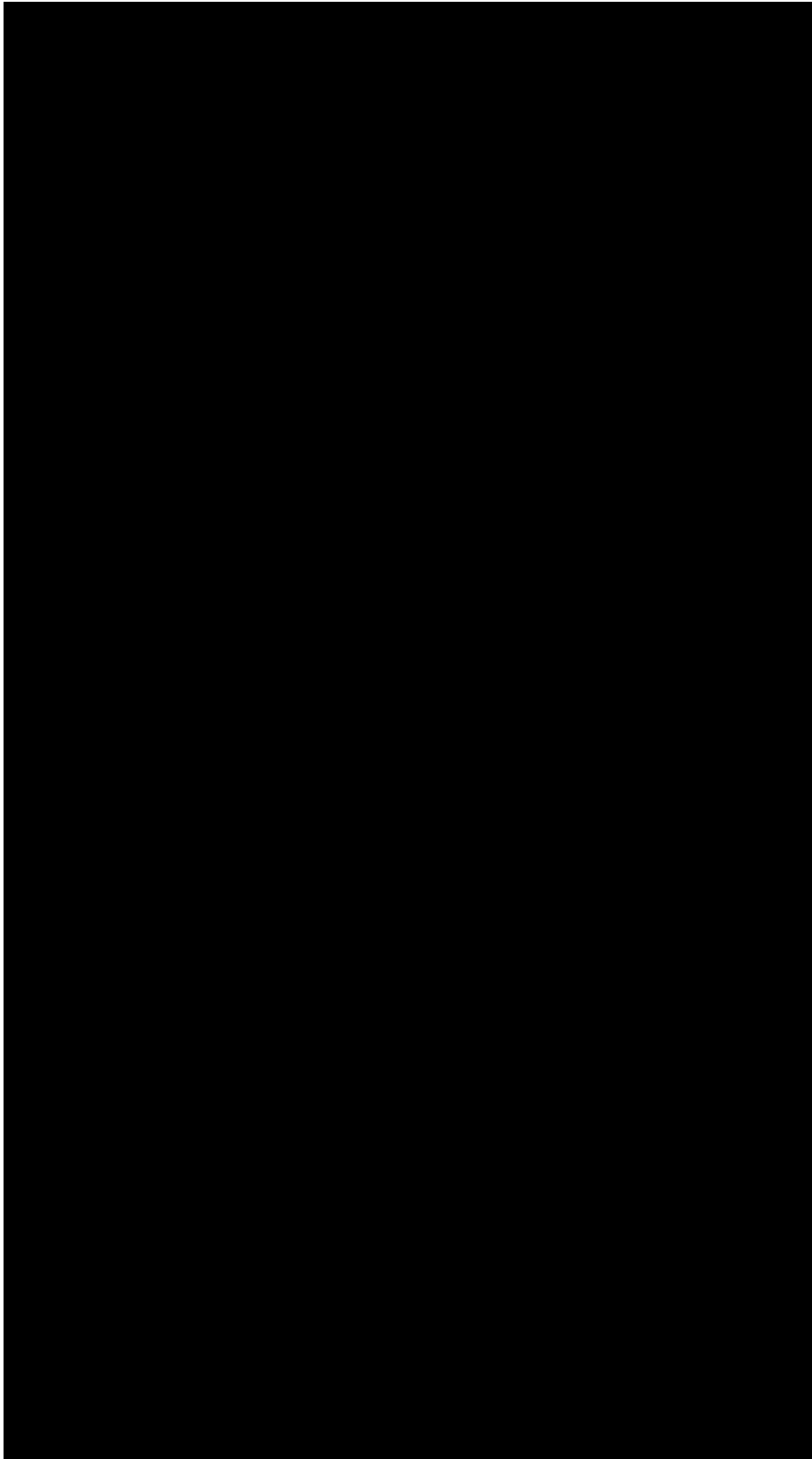
[REDACTED]

[REDACTED] Additionally, they were designing a watch with oxygen saturation measurements that were targeted to meet “the same standards that are used to assess clinical grade devices.” EX2078, 949:10-16. Waydo’s testimony is reproduced below:



A. We've tested the watch to the same standards that are used to assess clinical grade devices, and we meet the general accepted standards for accuracy of blood oxygen devices.

EX2078, 949:10-16.



[REDACTED]

EX2081, 174:5-8.

[REDACTED]

[REDACTED]

[REDACTED]

“[s]hrinking things down to be much smaller package and use substantially less power and to be used by a consumer in a nonprescription environment” and

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

⁴ The Series 0 Watch was released in Spring 2015. EX2076, 956:9-957:1.

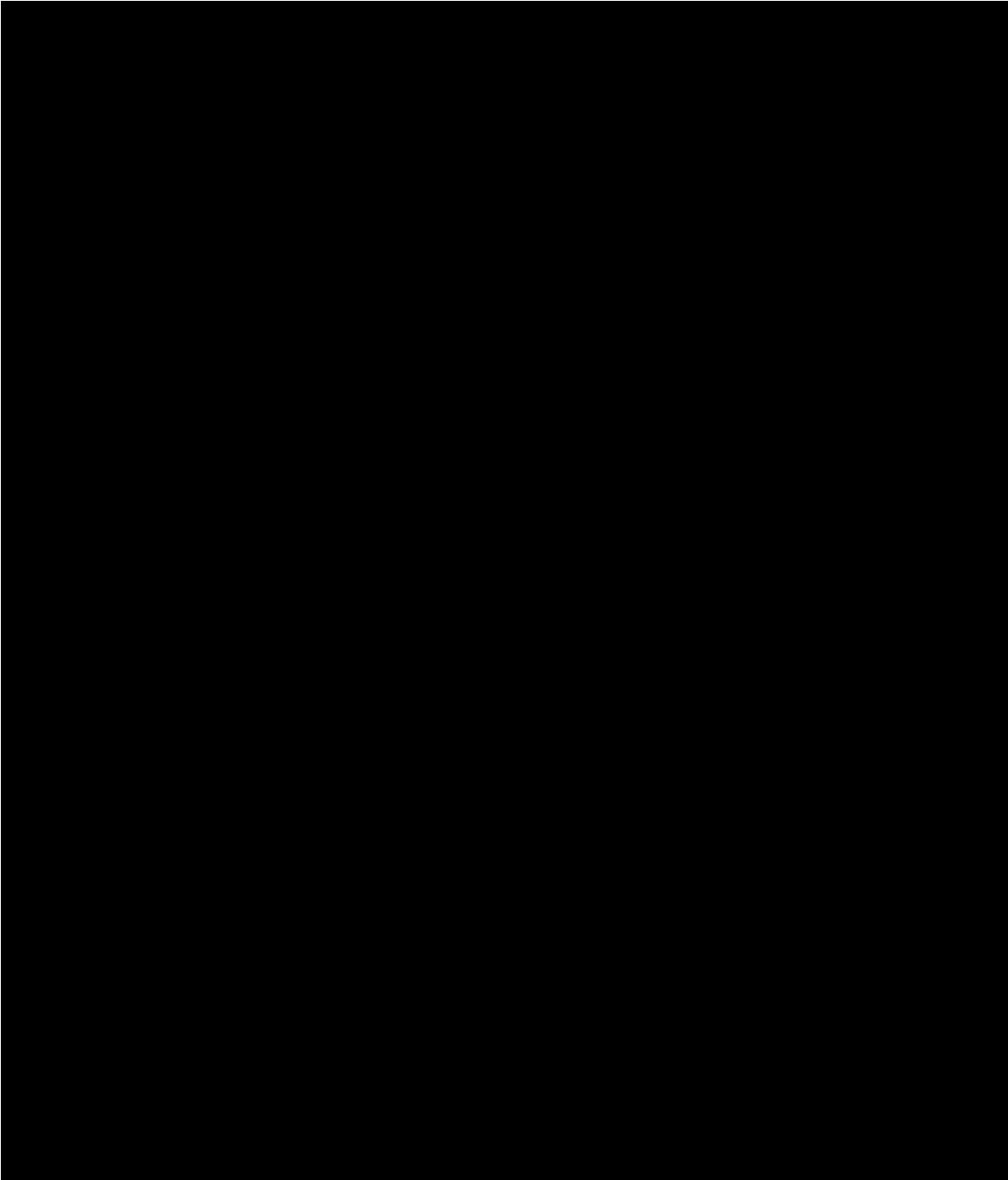
[REDACTED]

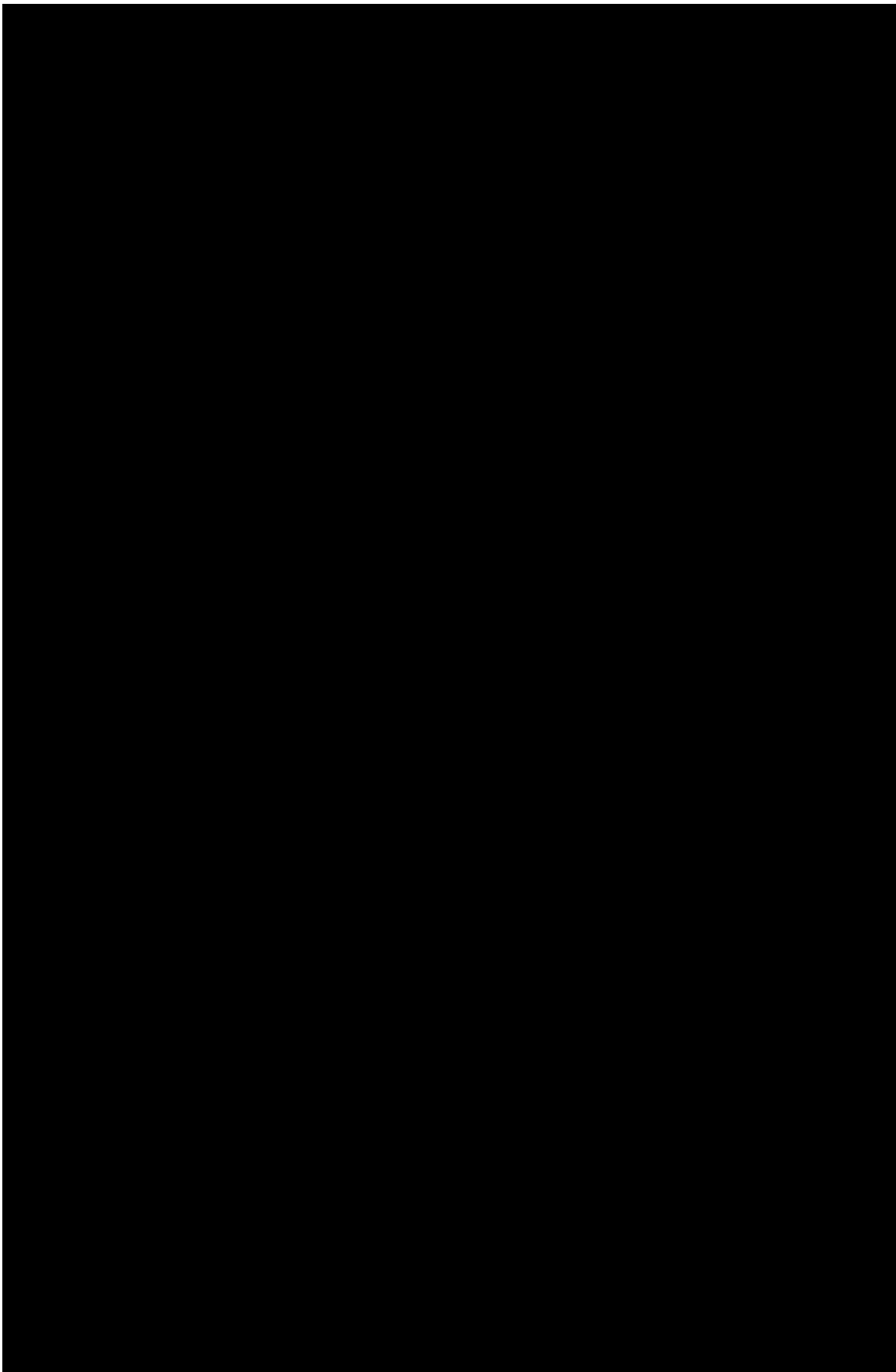
[REDACTED]

[REDACTED]

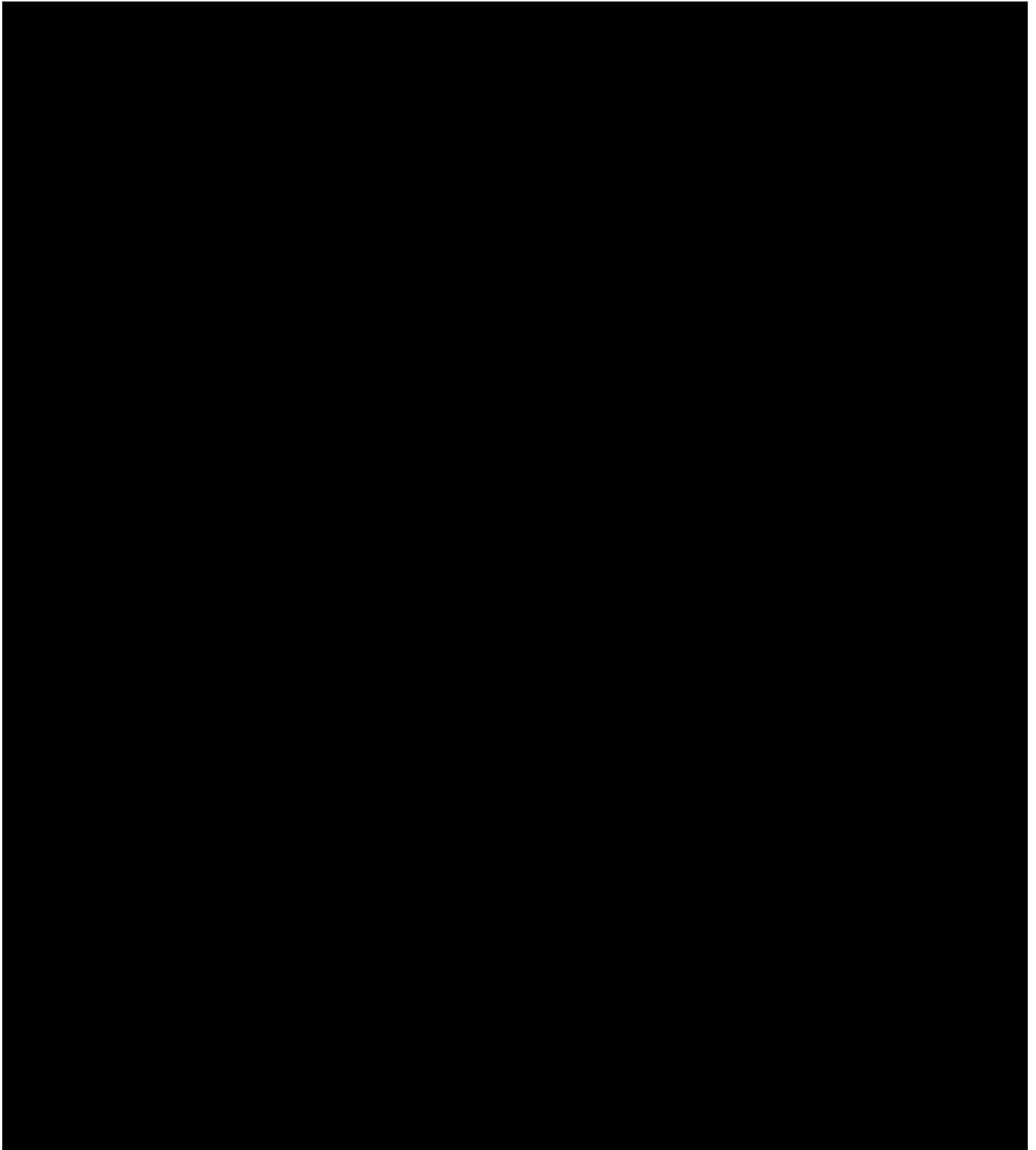
The wrist is just an incredibly different beast. The vascular densities are very small and sparse. It was going to be the first challenge. Shrinking things down to be much smaller package and use substantially less power and to be used by a consumer in a nonprescription environment would ultimately add to additional challenges to think through and work through.

EX2077, 999:5-11.





61. The use case and accuracy goals and requirements were captured in presentation slides dated July 30, 2015, reproduced below.



[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

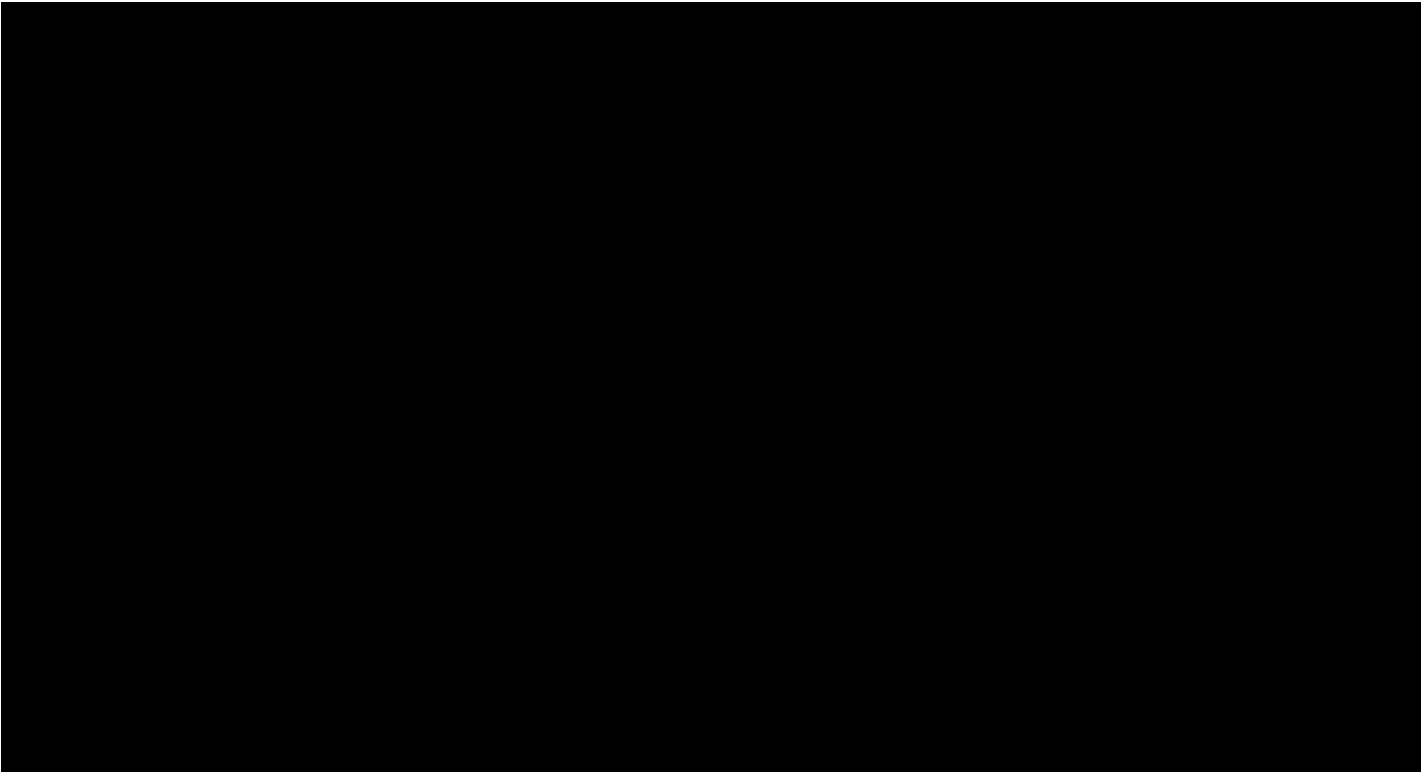
[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]



63. In its response, Patent Owner misrepresents and mischaracterizes the record evidence. 



 Patent Owner’s evidence itself suggests that measuring oxygen saturation under room air was feasible at least as of April 20, 2016—much earlier than suggested by the Patent Owner, who seem to misconstrue and incorrectly rely on Mannheimer’s subjective and exhilarating expressions (e.g., “rolling my eyes,” “good luck with that”) for support, rather than any objective evidence. POR, 46 (citing EX2080, 174:19-175:5 (testifying that work started in 2015 and launched “a

commercial product” in 2020)). Patent Owner’s arguments on no reasonable expectation of success are not supported by the facts.

5. Iwamiya-Sarantos renders obvious an opening defined in the dark-colored coating with a different length and width (Claims 13 and 20)

64. In my First 743 Declaration, I explained that a POSITA would have found it obvious and beneficial to implement the window defined by Iwamiya’s light shielding frame 18 to have a width that is larger than a length of the window, based on the teachings of Sarantos. APPLE-1003, ¶¶96-97. A POSITA would have recognized the benefits from using the improved “high-aspect ratio” (“HAR”) photodiodes disclosed by Sarantos and the corresponding window regions (openings) having the same corresponding shape. *Id.*; APPLE-1005, 9:47-65; 9:48-10:26, 17:42-47 (“the window regions 2226 are mutually coextensive with their respective HAR photodetector elements 2212.”), FIGS. 15-16, 18. As I discussed in Section II.A.1, above), a POSITA would have recognized the benefits of applying Sarantos’s suggestion to use a dark-colored coating on the surface of Iwamiya’s light shielding frame 18 and applying this teaching would include Sarantos’s teachings with respect to the shape of the opening in the dark-colored coating. For example, a POSITA would have recognized the benefits of using Sarantos’s high-aspect-ratio (HAR) photodiodes because they are expressly disclosed by Sarantos. For instance, Sarantos teaches that “a *significant*

performance increase may be realized by deviating from the typical square” photodetectors “of conventional PPG sensors.” APPLE-1005, 9:48-67. In another example, Sarantos explains that “[t]he present inventors have determined that the use of non-square photodetector elements in PPG sensors may provide a significant performance increase as compared with traditional PPG designs, which typically utilize square photodetector elements” while “maintaining essentially the same power consumption as a square photodetector element.” *Id.* 7:3-11.

65. As I discussed in my First 743 Declaration, Sarantos also describes that “the window regions 2226 through which the light reaches the HAR photodetector elements 2212 each overlap their respective HAR photodetector elements 2212” and “the window regions 2226 are mutually coextensive with their respective HAR photodetector elements 2212.” APPLE1005, 17:42-47; 243-APPLE-1003, ¶97. From this disclosure, a POSITA would have understood that the window regions defined in the dark-colored coating (the optical filter 17 positioned within Iwamiya’s light shielding frame 18 in the predictable combination) includes a width and a length corresponding to the width and length of the respective non-square HAR photodiode, and thus has a width that is larger than the length in at least some configurations of the predictable combination of Iwamiya with Sarantos.

6. Iwamiya and Sarantos Disclose a Length and a Width of the Output Light Pattern (Claim 9)

66. Recall that Iwamiya teaches that the “annular light guide unit 7 [] guides the observation light emitted from the light emitting units 6 and annularly diffuses and irradiates the observation light with respect to a skin H.” APPLE-1004, 6:7-14. This statement, makes clear, what a POSITA would have understood about the role of the annular light guide unit 7, and specifically that the shape and dimensions of the output light pattern correspond to the shape and dimensions of the guide unit 7 because the emitted light’s path is modified, controlled and shaped by the light guide unit 7.

67. Patent Owner argues that because the light guide is annular in shape, it cannot have a length or width. POR, 26-27. But Patent Owner’s statement relies on a narrow and unsupported interpretation of the claim. Claim 9 recites that “the output light pattern *comprises* a width and a length.” APPLE-1001, 16:19-21. Claim 9 does *not* specify where the length or width must be, or impose any limitation other than *any* width and *any* length *comprised in* in the output light pattern being different. In Iwamiya’s FIG. 2 below, I point to several possible lengths and widths that all be included in the light pattern, even if the light pattern and guide are annular in shape.

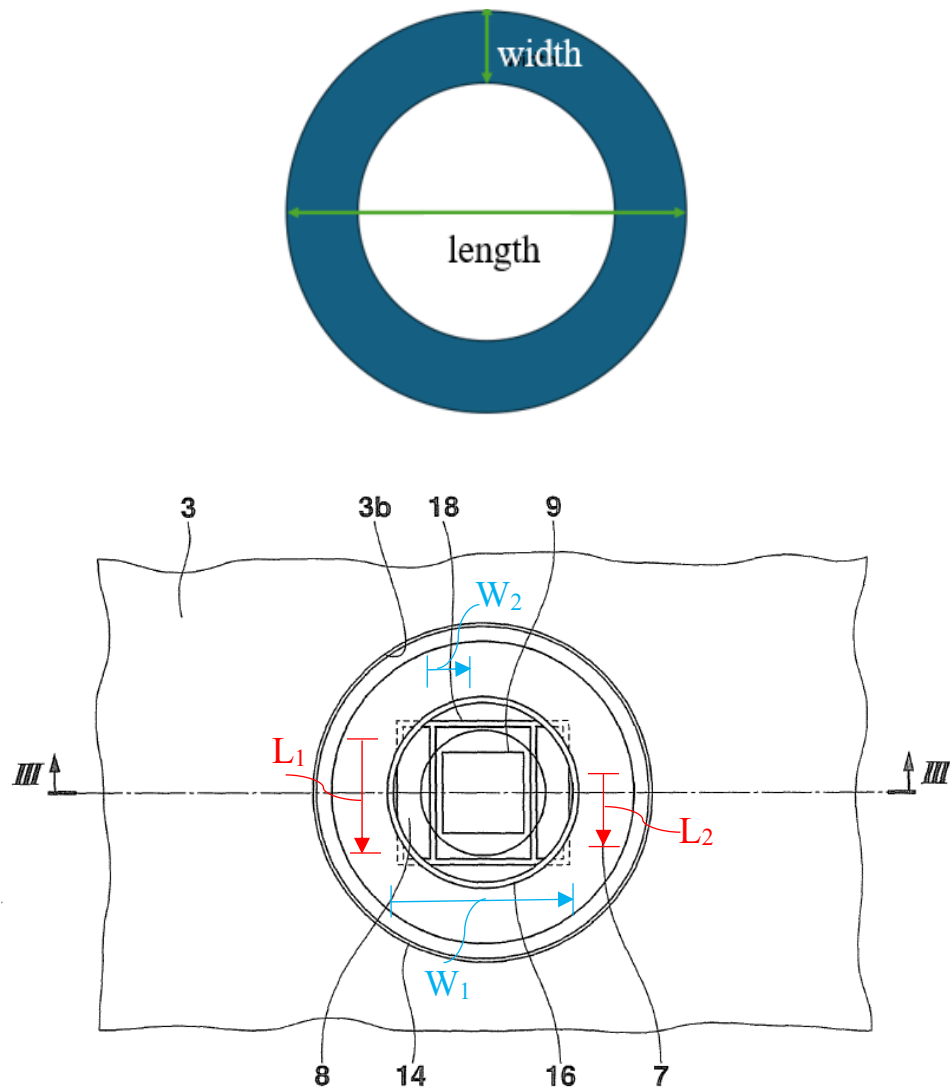
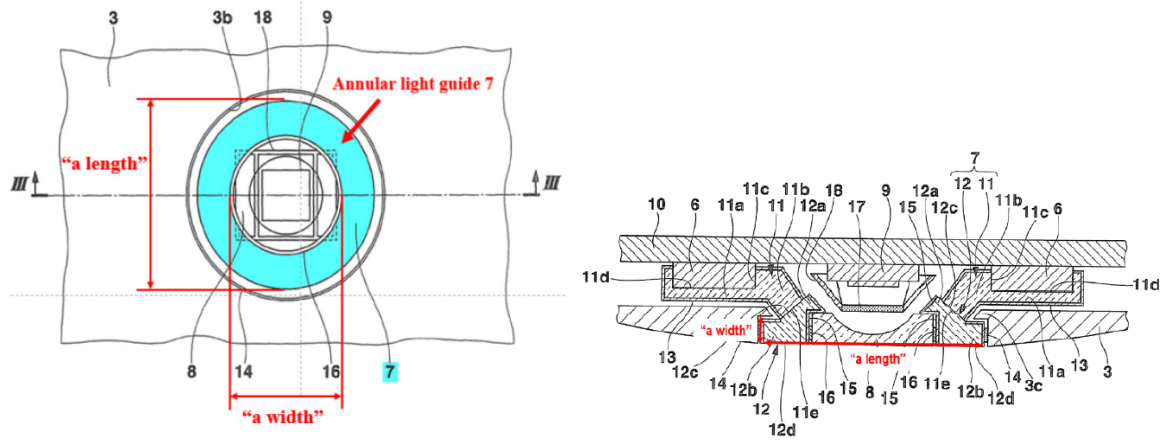


FIG.2

APPLE-1004, FIG. 2.

68. Notwithstanding the above, in my First 743 Declaration, I presented two example mappings (shown below) of how Iwamiya and Sarantos satisfy claim 9. APPLE-1003, ¶¶86-87.



APPLE-1004, FIGS. 2 (left), 4 (right).

69. In the first example (shown on the left above), one possible length and width are shown under a plan view of Iwamiya’s device. APPLE-1004, FIG. 2, 4:9-10. The length stretches from one end of the light pattern output by the guide unit 7 to a second end. The width stretches from one point of the light pattern to a second point of the light pattern. In the second mapping of claim 9 (shown on the right above), I provided another example in which the width of the output light pattern is provided in a different dimension than in the first mapping.

70. A length is defined as “the measurement of the extent of something along its greatest dimension.” APPLE-1095, 776. A width is defined as “the distance across something from one side to the other.” APPLE-1095, 1542. For example, in some cases, the width of the annulus can be calculated by subtracting the radius of the inner circle from the radius of the outer circle. Consistent with the above-noted definitions, a POSITA would have understood that Iwamiya and

Sarantos disclose a length and width of an output light pattern that are different, as shown in the figures above.

7. Masimo Concedes that Iwamiya Discloses an Oval-Shaped Pattern (Claim 10)

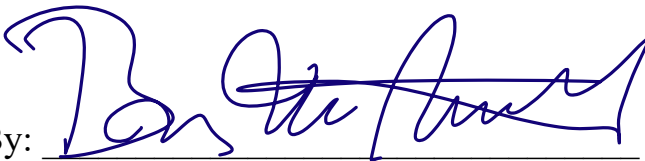
71. Patent Owner acknowledges that Iwamiya discloses an annular light guide unit. POR, 27 (“As shown in Iwamiya, the annular light guide”), 26. Iwamiya discloses that “[t]he light guide unit 7 comprises a light guiding ring portion 11 ... [that] is formed in *almost a ring shape*” including a flat ring portion 11a and inclined ring portion 11b. APPLE-1004, FIGS. 2, 3, 6:40-52. Moreover, the dictionary definition of “annular” is “shaped like or forming a ring.” and a POSITA would have understood that a ring encompasses an oval shape. APPLE-1095, 55. This understanding of “ring” is consistent with the use of “ring,” for example when describing oval-shaped rings around planetary objects or describing jewelry around a finger. And because a POSITA would have understood that the shape of the output light pattern would correspond to the shape of the guide unit 7 (as noted above in Section II.A.6), a POSITA would have found it obvious that an annular guide unit would generate an annular output light pattern, which encompasses, *by definition*, an oval shaped light pattern.

III. CONCLUSION

72. I currently hold the opinions set expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

73. I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare 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 the Title 18 of the United States Code.

Dated: 2/13/25

By: 

Dr. Brian W. Anthony