IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Gloria Lin, et al.	
U.S. Patent No.:	10,076,257	Attorney Docket No. 50095-0150IP1
Issue Date:	August 11, 2020	
Appl. Serial No.:	14/136,658	
Filing Date:	December 20, 2013	
Title:	SEAMLESSLY EMBEDDED HEART RATE MONITOR	

DECLARATION OF DR. THOMAS W. KENNY

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.

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: January 21, 2024 By: 

Thomas W. Kenny, Ph.D.

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I. QUALIFICATIONS AND BACKGROUND INFORMATION

1. My education and experience are described more fully in my *curriculum vitae*, attached as Appendix A to this declaration. For ease of reference, I have highlighted certain information below.

2. My academic and professional background is in Physics, Mechanical Engineering, Sensing, and Robotics, with a research specialization focused on microfabricated physical sensors, and I have been working in those fields since the completion of my Ph.D. more than 30 years ago. The details of my background and education and a listing of all publications I have authored in the past 35 years are provided in my curriculum vitae, attached as Appendix A. Below I provide a short summary of my education and experience which I believe to be most pertinent to the opinions that I express here.

3. I received a B.S. in Physics from University of Minnesota, Minneapolis in 1983, and a Ph.D. in Physics from University of California at Berkeley in 1989. I was educated as a Physicist specializing in sensors and measurement. My Physics Ph.D. thesis involved measurements of the heat capacity of monolayers of atoms on surfaces, and relied on precision measurements of temperature and power using time-varying electrical signals, and also on the design and construction of miniature sensor components and associated electrical circuits for conditioning and conversion to digital format.

4. After completion of my Ph.D. in Physics at U.C. Berkeley in 1989, I joined the Jet Propulsion Laboratory (JPL) in Pasadena, CA, as a staff scientist, and began working on miniature sensors and instruments for small spacecraft. This work involved the use of silicon microfabrication technologies for miniaturization of the sensors, and served as my introduction to the field of micro-electromechanical systems (MEMS), or the study of very small mechanical sensors powered by electricity and used for detection of physical and chemical signals.

5. While at JPL, we developed accelerometers, uncooled infrared sensors, magnetometers, seismometers, force and displacement sensors, soil chemistry sensors, miniature structures for trapping interstellar dust, and many other miniature devices. Some of these projects led to devices that were launched with spacecraft headed for Mars and for other interplanetary missions. Much of this work involved the use of physical sensors for detection of small forces and displacements using micromechanical sensors.

6. I am presently the Richard Weiland Professor at the Department of Mechanical Engineering at Stanford University, where I have taught for the past 30 years. I am also currently the Senior Associate Dean of Engineering for Education and Student Affairs at Stanford.

7. For almost all of these 30 years, I have taught courses on Sensors and Mechatronics at Stanford University. The "Introduction to Sensors" course is a

broad overview of all sensing technologies, from thermometers, to inertial sensors, ultrasound devices, flow sensors, optical and IR sensors, chemical sensors, pressure sensors, and many others, and has included sensors based on changes in capacitance, resistance, piezoelectricity. This course specifically included different mechanisms for sensing heart rate, blood pressure, blood chemistry, cardiovascular blood flow and pressure drops, intraocular pressure and other physiological measurements, as well as activity monitoring (step counting, stair-counting, etc). I first taught this course at Stanford in the Spring of 1994, and I offered this course at least annually until 2016, when my duties as Senior Associate Dean made this impractical, yet have continued to offer this course periodically since, including these last two years.

8. The "Introduction to Mechatronics" course is a review of the mechanical, electrical and computing technologies necessary to build systems with these contents, which include everything from cars and robots to cellphones and other consumer electronics devices. In this class, we routinely use IR, LEDs, and photosensors as a way of detecting proximity to objects in the space around miniature robots. We also use inertial sensors to detect movement, and a number of sensors, such as encoders to measure changes in position and trajectory. I was one of the instructors for the first offering of this course in 1995, and this course has been offered at least once each year ever since, except for the pandemic year of

2021. The 2023 offering was highly-successful with 80 undergraduate and graduate students from many engineering and science disciplines.

9. I am co-author of a textbook titled "Introduction to Mechatronic Design," which broadly covers the topic of integration of mechanical, electronic and computer systems design into "smart products." This textbook includes chapters on Microprocessors, Programming Languages, Software Design, Electronics, Sensors, Signal Conditioning, and Motors, as well as topics such as Project Management, Troubleshooting, and Synthesis.

10. My research group at Stanford has focused on the area of microsensors and microfabrication—a domain in which we design and build micromechanical sensors using silicon microfabrication technologies. The various applications for these technologies are numerous.

11. I have advised 75 Ph.D. students that have completed Ph.D. degrees and many more M.S. and B.S. students in Engineering during my time at Stanford.

12. I have published over 250 technical papers in refereed journals and conferences in the field of sensors, MEMS, and measurements. I have further presented numerous conference abstracts, posters, and talks in my field. I am a named inventor on 50 patents in my areas of work.

13. From 2020 to 2022 I served as CEO of Applaud Medical, a startup that I co-founded in 2015. Applaud is developing improved methods for treatment

of kidney stones, and during my time as CEO, we initiated a FDA-regulated pivotal clinical trial on our first product, concluded an Australian clinical study on our second product, and positioned the company for on-boarding of an experienced CEO with resources to guide the company through all remaining trials and to a successful outcome.

14. I received the Office of the Secretary of Defense Award for Exceptional Public Service in 2010, the IEEE Sensors Council Technical Achievement Award in 2011, and was named Fellow of the ASME in 2014. I was awarded the 2018 IEEE Daniel Noble Award for Emerging Technologies. In 2022, I was elected to the National Academy of Engineering.

15. I have previously served as an expert on patent infringement cases related to the design and use of inertial sensors, sensors of physiological parameters, optical proximity sensors, and other sensor-based technologies and applications, as well as other topics. My CV, Appendix A, includes a full listing of all cases in which I have testified at deposition or trial in the preceding several years.

16. I have been retained on behalf of Apple Inc. to offer technical opinions relating to U.S. Patent No. 10,076,257 ("the '257 Patent") and prior art references relating to its subject matter. I have reviewed the '257 Patent, and relevant excerpts of the prosecution history of the '257 Patent. Based on my

experience and education, and the acceptance of my publications and professional recognition by societies in my field, I believe that I am qualified to offer opinions as to the knowledge and level of skill of one of ordinary skill in the art at the time of the invention of the ’257 patent (which I further describe below).

17. In addition to any materials cited in the present declaration, I have also reviewed the following references:

- EX1001 U.S. Patent No. 10,076,257 B2
- EX1002 Prosecution History of U.S. Patent No. 10,076,257 B2
- EX1003 Declaration of Alan L. Oslan (“Oslan Declaration”)
- EX1004 Curriculum vitae of Alan L. Oslan
- EX1005 U.S. Pat. Pub. No. 2007/0021677, published January 25, 2007 (“Markel”)
- EX1006 U.S. Pat. No. 5,351,695, issued Oct. 4, 1994 (“Mills”)
- EX1012 Leslie Cromwell et al., Biomedical Instrumentation and Measurements (1973)
- EX1013 US Pat. Pub. No. 2005/0033284
- EX1014 ABS Plastic Properties, ADECRO PLASTICS
- EX1015 Nave, Conductors and Insulators, HYPERPHYSICS
- EX1016 Excerpt, Merriam-Webster’s Collegiate Dictionary (11th ed. 2004), embedded

- EX1017 Excerpt, Random House Unabridged Dictionary, "embedded"
- EX1018 Excerpt, American Heritage Dictionary of the English Language, "embedded"
- EX1019 Excerpt, Wiley Electrical and Electronics Engineering Dictionary, "lead"
- EX1020 Excerpt, Stedman's Medical Dictionary, "lead"
- APPLE-2004 Joint Claim Construction Brief for Apple Asserted Patents from *Apple Inc. v. Masimo Corporation et al.*, Case No. 1-22-cv-01378 (D. Del. Oct. 20, 2022)
- APPLE-2005 Definition of "embedded" from Wiley Electrical and Electronics Engineering Dictionary, IEEE Press, Wiley-Interscience (2004)
- APPLE-2006 Definition of "embed" from Merriam-Webster's Collegiate Dictionary, Eleventh Edition, Merriam-Webster, Inc. (2005)
- APPLE-2007 Definition of "embed" from Webster's College Dictionary, Random House (2005)
- APPLE-2008 Transcript of January 12, 2024 deposition of Alan L. Oslan

I have also reviewed various supporting references and other documentation as further noted in my opinions below.

18. Counsel has informed me that I should consider these materials through the lens of one of ordinary skill in the art related to the '257 Patent at the time of the earliest possible priority date of the '257 Patent, and I have done so during my review of these materials. The '257 Patent claims the benefit of priority

to a provisional application filed November 5, 2008 ("the Critical Date"). Counsel has informed me that the Critical Date represents the earliest possible priority date to which the challenged claims of '257 Patent are entitled, and I have therefore used that Critical Date in my analysis below.

19. I have no financial interest in the parties or in the outcome of this proceeding. I am being compensated for my work as an expert on an hourly basis. My compensation is not dependent on the outcome of these proceedings or the content of my opinions.

20. In writing this declaration, I have considered the following: my own knowledge and experience, including my work experience in the fields of mechanical engineering, computer science, biomedical engineering, and electrical engineering; my experience in teaching those subjects; and my experience in working with others involved in those fields. In addition, I have analyzed various publications and materials, in addition to other materials I cite in my declaration.

21. My opinions, as explained below, are based on my education, experience, and expertise in the fields relating to the '257 Patent. Unless otherwise stated, my testimony below refers to the knowledge of one of ordinary skill in the art as of the Critical Date, or before. Any figures that appear within this document have been prepared with the assistance of Counsel and reflect my understanding of the '257 Patent and the prior art discussed below.

II. OVERVIEW OF CONCLUSIONS FORMED

22. This declaration explains the conclusions that I have formed based on my analysis. To summarize those conclusions, based upon my knowledge and experience and my review of the prior art publications listed above, I believe that:

- Mills does not anticipate claims 1-4, 8, 10, 11, and 14 of the ’257 Patent
- Markel in view of Mills does not render obvious claims 1-4 and 8-22 of the ’257 Patent

III. LEVEL OF ORDINARY SKILL IN THE ART

23. In my opinion, a person of ordinary skill in the art as of the Critical Date of the ’257 Patent (hereinafter a “POSITA”) would have had at least a bachelor’s degree in electrical engineering, mechanical engineering, biomedical engineering, computer engineering, physics, or a related field, and would have had at least two years of relevant work experience with capture and processing of data or information, including but not limited to physiological information, or equivalents thereof. Less work experience may be compensated by a higher level of education and vice versa.

24. Based on my knowledge, skill and experiences, I have a good understanding of the capabilities of one of ordinary skill. Indeed, I have taught, participated in organizations, and worked closely with many such persons over the

course of my career. For example, from my industry experience, I am familiar with what an engineer would have known and found predictable in the art. From teaching and supervising my post-graduate students, I also have an understanding of the knowledge that a person with this academic experience possesses. Furthermore, I possess those capabilities myself.

IV. CLAIM CONSTRUCTION

25. I understand the Patent Trial and Appeal Board ("Board") construes claim terms as having their ordinary and customary meaning to a POSITA at the time of invention (i.e., the same standard used in district court). I have applied this standard in rendering my opinions on claim construction. In addition, I have been asked to assume that the claims are not indefinite.

26. I have noted that Masimo has proposed constructions for several terms in the Petition. In my opinion, Masimo's constructions of terms relevant to this proceeding below are improperly broad. For this reason, I have presented constructions having a proper scope for these terms.

27. **"embedded in"** (claims 1, 15) – Mr. Oslan proposes a construction for "embedded" of "'an integral part of' such as, by 'being placed in the thickness of a surrounding material including forming an outer and/or inner surface' or 'placed underneath an exterior surface and against an inner surface.'"

28. In my opinion, this construction for "embedded" is far too broad, as it would include many examples of objects positioned relative to other objects that a POSITA would not understand as "embedded".

29. For example, in Mr. Oslan's deposition testimony, there were a series of questions about the relationship between objects placed into contact with one another, including an example of a first object and a second object with flat surfaces. In response to these questions, Mr. Oslan confirmed his understanding of one component adjacent to or in contact with the flat surface of another component as not being "embedded". To do so, Mr. Oslan relied on his determination that such a first object with a flat surface in contact with the flat surface of a second object was not an "integral part" of the second object:

> "By Mr. Bisenius: Q. Well, I've got a book here. So, the book has a flat surface; my desk has a flat surface. If I place the book on my desk so the two flat surfaces are in contact with each other, is this book embedded in the desk?
>
> MR. EVERTON: Objection to form.
>
> THE WITNESS: It's not an integral part of and -- such as -- you know, it's not being placed in the thickness of the surrounding material, including forming an outer or inner surface, or placed underneath an exterior surface and against an inner surface.

BY MR. BISENIUS: correct Q. If I take the book and I put it under my desk and I hold the flat surface against the bottom flat surface of my desk, now it's underneath the exterior surface. Is this book embedded in the tabletop of my desk?

MR. EVERTON: Objection to form.

THE WITNESS: It's not an integral part of your desk."

APPLE-2008, 32:18-33:18.

Mr. Oslan relies on the requirement that an embedded object must be an "integral part" of the object it is embedded in to determine that a flat object is not embedded in the flat surface of another object. Mr. Oslan is asserting that an object in contact with the flat surface of another object is not embedded because it is not an integral part, even though such an object is "…'an integral part of' such as, by being …'placed underneath an exterior surface and against an inner surface.'

Mr. Oslan appreciates that a POSITA would never consider a book placed in contact with the top of a table or placed in contact underneath a table to be embedded.

- In order to rectify the obvious example of a book placed on the top of a table not being embedded with the proposed construction, Mr. Oslan points out that the book placed on top of a table is "…not an integral part of and -- such as -- you know, it's not being placed in the thickness of the

surrounding material, including forming an outer or inner surface, or placed underneath an exterior surface and against an inner surface." In this first example, Mr. Oslan relies on his further definition of "integral part", which is that it is"…placed underneath an exterior surface and against an inner surface." in order to support the obvious determination that a book on a table is not embedded in the table.

- In order to rectify the obvious example of a book placed in contact under a table not being embedded with the proposed construction, he points out that the book placed on top of a table is simply "… not an integral part of your desk." In this second example, Mr. Oslan overlooks his further definition of "integral part" in order to support the obvious determination that a book in contact under a table is not embedded in the table.
- We see in this pair of examples that Mr. Oslan sometimes relies on portions of his indefinite understanding of "integral part" in order to rectify this proposed construction with these obvious examples of objects not embedded.

Notably, "integral" or "integral part" do not appear anywhere in the specification or claims of the '257 patent. Furthermore, it appears that Mr. Oslan departs from his proposed definition of "integral part" in determining that a book on or under a table being is not an "integral part", and therefore not embedded.

30. Simply put, Masimo's construction of "embedded" is too broad, as even Dr. Oslan must overlook the included definition for "integral part" in order to exclude the obvious examples of a book in contact with a table from being "embedded".

31. In my opinion, the term "embedded in" should be given its plain and ordinary meaning, which does not require an explicit construction. A POSITA would have known what it means for a first material, structure, or component to be "embedded in" a second material, structure, or component based on both the plain and ordinary meaning of this term and the way in which this term is used in the '257 patent specification, which conforms with the plain and ordinary meaning. However, should it be necessary to define the parameters of the plain and ordinary meaning for this term, an express construction of the term "embedded in" that a POSITA would have recognized as consistent with the plain and ordinary meaning of this term is "at least partially set in or partially surrounded by a material." This construction is both consistent with the plain and ordinary meaning of the term "embedded in" and supported by the use of the term "embedded in" in the specification and claims of the '257 patent. This construction is also consistent with the determination by Mr. Oslan that a book on or under a table is not embedded in the table, and clearly leads to this determination without any need to

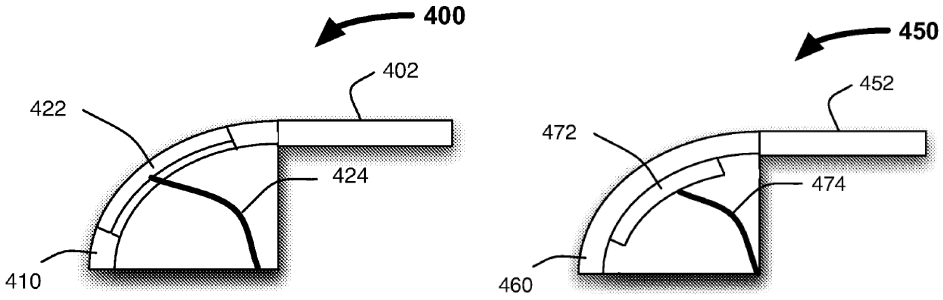
overlook portions of the construction or rely on any overly broad terms in the proposed construction.

32. The ’257 patent uses the term “embedded” throughout, including in the title. The various uses of the term “embedded” also indicate that the claim term “embedded in” has a narrower meaning than the term “embedded” on its own as used in the specification. This is demonstrated by several examples from the ’257 patent specification in which the term “embedded in” is used in contrast to other terms such as “embedded adjacent to” or “embedded along.” In a first example, in a section toward the end of the detailed description of the ’257 patent that describes the invention in general, the ’257 patent states that in embodiments where the device includes “a housing forming the exterior surface” that “one or more leads can be ***embedded in*** ***or*** ***adjacent to*** the housing.”[1] EX1001, 10:24-29. A POSITA would have recognized that this section clearly distinguishes between a lead that is “embedded in” the housing and a lead that is merely positioned “adjacent to” the housing (such as by being positioned underneath a portion of the housing). Based on this example in the ’257 patent, a POSITA would have recognized that for the lead to be “embedded in” the housing requires more than the lead and a portion of the housing to be positioned such that the lead is merely

[1] All emphasis added unless otherwise noted.

in contact with a flat interior surface or otherwise simply adjacent to a portion of the housing. Rather, this example from the specification of the '257 would guide a POSITA to understand that for a first object to be "embedded in" another object at least a portion of the first object, such as an embedded lead or pad, must be at least partially set in or partially surrounded by a second material or component (e.g., a portion of the enclosure). Therefore, a POSITA would distinguish a first material or component that is "embedded in" another material or component from a first material or component that is merely "embedded adjacent to" another material or component, or in contact with a flat surface of another component.

33. The '257 patent gives another example that makes this distinction clear with respect to Figure 4B, which is described as "…a cross-sectional view of another illustrative electronic device having a bezel with an embedded heart sensor lead…" EX1001, 3:33-35. Specifically, the '257 patent specification describes two alternative arrangements for the lead 472 with respect to Figure 4B.



Left: '257 Patent, FIG. 4A; Right: '257 Patent, FIG. 4B

34. In a first arrangement described with respect to Figure 4B, the '257 patent describes that "lead 472 of the heart sensor can be ***positioned against*** the back surface of bezel 460." EX1001, 9:44-45. As shown in the figure, the lead 472 and the back surface of bezel 460 are both curved, with the lead 472 embedded in the bezel 460 because of the position of the lead 472 on the inside curved surface of the bezel 460. This is consistent with the understanding of a POSITA as discussed above, which would distinguish a first material or component that is "embedded in" another material or component from a first material or component that is merely "embedded adjacent to" another material or component, or in contact with a flat surface of another component. The lead 472 is embedded in the bezel 460 because it is positioned on the inside curved surface of the bezel, which is clearly distinct from the examples discussed in Mr. Oslan's deposition of a book being placed in contact with the flat lower surface of a table.

35. The specification then describes an alternative arrangement for the lead 472 with respect to the bezel, stating "***[a]lternatively***, lead 472 can be ***placed within the thickness of bezel*** 460 (e.g., in a pocket within the bezel wall), but underneath the outer surface of the bezel." *Id.*, 9:45-48. This passage once again demonstrates the clear distinction between a lead that is embedded in a portion of the enclosure in contrast to a lead that is merely "positioned against" or in parallel contact with a portion of the enclosure. It is not sufficient that the lead/pad be in

parallel contact with the first portion of the enclosure to be "embedded in," the lead/pad needs to be at least partially surrounded by or at least partially set in the first portion of the enclosure. Specifically, the proposed construction requires that the lead be at least partially set in or partially surrounded by a material.

36. Other portions of the '257 patent further support an interpretation of "at least partially set in or partially surrounded by a material" for the term "embedded in," consistent with the plain and ordinary meaning of this term. For example, the '257 patent describes an embodiment in which a lead is included in the touch screen. In describing this embodiment, the '257 patent refers to an "additional lead 326 ***embedded in or behind*** display 302." EX1001, 8:40-41. This section offers another example of the term "embedded in" having a narrower meaning than the term "embedded" by distinguishing between a lead that is "embedded in" a portion of the enclosure verses a lead that is merely "behind" the portion of the enclosure. EX1001, 8:40-41. To be clear, a lead/pad can be both "embedded in" and "embedded behind" a portion of an enclosure, and indeed claim 1 requires this configuration. However, this example demonstrates that something more than merely being positioned behind the first portion of the enclosure is required for the lead/pad to be "embedded in" the first portion of the enclosure. Specifically, the proposed construction requires that the lead be at least partially set in or partially surrounded by a material.

37. In another example, the ’257 patent indicates that there are multiple ways in which leads “can be coupled to sides 312 and 314 of bezel 310” with one specific manner being that “leads 322 and 324 [are] ***embedded directly in*** bezel 310.” EX1001, 8:20-24, 8:67-9:1. This once again identifies a distinction between leads that are merely in contact with the bezel 310 of the device housing and leads that are “embedded directly in” the bezel. In other words, a lead that is embedded in the bezel 310 must be at least partially set in or partially surrounded by the bezel 310.

38. I also note that the claims of the ’257 use the term “embedded in” while also using the word “embedded” in other context, which once again indicates that the term “embedded in” has a different scope from the broader term “embedded. For example, claim 1 recites “a first lead comprising a first pad that is embedded ***in*** a fist portion of the enclosure” while claim 9 recites “a third lead embedded ***with*** the display.” As would have been apparent to a POSITA, the term “embedded in” has a different scope than the term “embedded with.” A POSITA would have recognized that in the context of the ’257 patent, the term “embedded in” has a narrower scope than “embedded with.” Specifically, a lead that is “embedded in” a first portion of the enclosure would be at least partially set in or partially surrounded by the first portion of the enclosure rather than merely being “embedded with” or adjacent/parallel to the first portion of the enclosure.

39. These various examples in the ’257 patent demonstrate that Mr. Oslan’s construction for the term “embedded” is overly broad with respect to the actual term recited in claims 1 and 15 of “embedded in.” Mr. Oslan proposes a construction for “embedded” of “‘an integral part of’ such as, by ‘being placed in the thickness of a surrounding material including forming an outer and/or inner surface’ or ‘placed underneath an exterior surface and against an inner surface.’” EX1003, ¶46. It is the last, alternative portion of this construction in particular that is not compatible with the narrower term “embedded in.” Specifically, the second, alternative portion of this construction of “placed underneath an exterior surface and against an inner surface” is overly broad in the context of the term “embedded in.” This is demonstrated by the examples that I discussed above regarding the manner in which the ’257 patent distinguishes the term “embedded in” from arrangements in which two materials that are merely positioned “adjacent to” or “against” each other such that the two surfaces are parallel rather than the first material being “embedded in” the second material by being at least partially set in or partially surrounded by the second material. The fact that Mr. Oslan did not consider the above described examples in the ’257 patent which demonstrate the distinctions between “embedded in” and “embedded adjacent to” when formulating his construction of the broader term, “embedded” reveals that he did not consider the full context of the use of the term “embedded in” in contrast to the related term

"embedded" within the '257 patent. *See* APPLE-2008, 34:20-35:3, 124:7-16, 126:2. The fact that Mr. Oslan addressed only the broader term "embedded" but did not consider the term "embedded in" even though that term is recited in the independent claims has led to an overly broad construction on his part. APPLE-2008, 31:4-8 (Mr. Oslan stating that he "only address[ed] 'embedded' in my declaration" rather than the term "embedded in" recited in the independent claims). The second half of Mr. Oslan's construction of a first material "placed underneath an exterior surface and against an inner surface" of a second material is simply not applicable to the narrower term "embedded in." As I have noted above, during his deposition, Mr. Oslan agreed that a first component or object in parallel contact with and positioned under a second component or object would not necessarily indicate that the first component or object is embedded in the second component or object. APPLE-2008, 31:10-33:18, 109:18-110:19.

40. Various dictionary definitions of the terms "embedded" and "embed" similarly support the above conclusion that the plain and ordinary meaning for the term "embedded in" as it is used in the '257 patent is "at least partially set in or partially surrounded by a material." For example, a POSITA would have been aware that in the context of computing devices and computing technology, the term "embedded" means "[t]hat which has been ***incorporated into a surrounding mass or enclosure***." APPLE-2005, 3. This definition taken from the Wiley Electrical

and Electronics Engineering Dictionary indicates to a POSITA that the term "embedded in" requires more than two materials or substrates that are merely positioned adjacent to, parallel, or against each other. *Id.*

41. Other dictionary definitions for the related term "embed" also support this plain and ordinary meaning of the term "embedded in." For example, Merriam-Webster's defines "embed" as "to enclose closely in or as if in a matrix" or "to make something an integral part of." EX2004, 3; *see also* EX2005, 3 (defining "embed" as "to fix into a surrounding mass" or "***to envelop or enclose***"). The dictionary definitions relied upon by Mr. Oslan also support the plain and ordinary construction that I have presented here. For example, the dictionaries sited by Mr. Oslan similarly define the related word "embed" as "to enclose closely in or as if in a matrix," "to make something an integral part of," "envelope or enclose," or "to cause to be an integral part of a surrounding whole." EX1016, 4; EX1017, 4; EX1018, 3. Notably, even if these dictionary definitions were believed to support a broad interpretation for the term "embed" alone, as discussed above, the claim term "embedded in" indicates a narrower scope than that proposed by Masimo in the Petition.

42. I have also reviewed the definition for the term "embedded in" that Masimo has submitted in the related district court proceeding. Importantly, in that proceeding, Masimo has proposed a much narrower construction for the term

"embedded in" for the '257 patent of "set firmly into and surrounded by material." APPLE-2004, 57. This much narrower construction for the term "embedded in" (in contrast to the term "embedded," which Mr. Oslan provides a construction for in this proceeding) once again demonstrates the flaws in Mr. Oslan's construction here. A POSITA would have recognized that this district court construction of "embedded in" is much narrower than the construction proposed by Mr. Oslan for the term "embedded" in this proceeding. For example, Masimo's district court construction requires that a first material be "surrounded by" a second material and does not encompass arrangements in which a first material merely "form[s] an outer and/or inner surface" of a second material or is "placed underneath an exterior surface and against an inner surface" of the second material, as Mr. Oslan has proposed here.

43. I have noted that in supporting its narrower construction in the district court proceeding, Masimo asserts that "'embedded in' must be construed to be more than merely 'mounted on.'" APPLE-2004, 58-59, 61. Masimo further asserts that arrangements in which a first material is merely "'behind,' 'embedded along,' [or] 'adjacent to'" a second material do not fall within the scope of the term "embedded in." APPLE-2004, 61. Masimo goes on to distinguish "leads [that] are 'embedded ***along***' the bezel" from leads that are "embedded in" the bezel/housing. *Id.* (emphasis original). These various arguments made by Masimo in the district

court proceeding indicate that Mr. Oslan's construction, in particular the last portion of his construction of "placed underneath an exterior surface and against an inner surface," is overly broad and not an accurate definition for the term "embedded in."

44. Should Masimo be held to the significantly narrower construction of "embedded in" that it has advocated for in the district court, the contrasts between the cited references and the claims of the '257 patent that I outline in my analysis below become even more stark. In addition to failing to demonstrate how the cited references meet the claim recitations under the proper construction of this term, should Masimo be held to its district court construction for the term "embedded in" in this proceeding, Masimo's failure to demonstrate how the cited references meet its proffered district court construction for "embedded in" is even more apparent. As I discuss below, under both Masimo's district court construction, and the proper plain and ordinary meaning of the term "embedded in," the cited references fail to disclose all of the recited claim limitations.

45. I would like to note that I also do not agree with the construction for "embedded in" proposed by Masimo in the district court proceeding. Specifically, I find the construction advanced by Masimo in the district court proceeding to be too narrow in that it does not encompass the full scope of the term "embedded in." For example, the specification discloses embodiments where the leads are ***exposed*** to a user and are thus not ***entirely*** "surrounded by material." As shown in Figure 4A, the embedded "lead 422" (shown in green) comprising the pad is only partially surrounded by the bezel 410 with a portion of the pad "***exposed to the user during use.***" EX1001, 9:22–24, Fig. 4A. As another example, the qualitative limitation-of-degree—"set ***firmly*** into"—in Masimo's district court construction adds ambiguity to a straightforward term. This assertion of "set ***firmly*** into" begs the question, how firm must it be set to be considered "embedded"? Accordingly, Masimo's district court construction is also improper because it is vague and a practitioner would not be able to determine if a proposed arrangement infringed this claim.

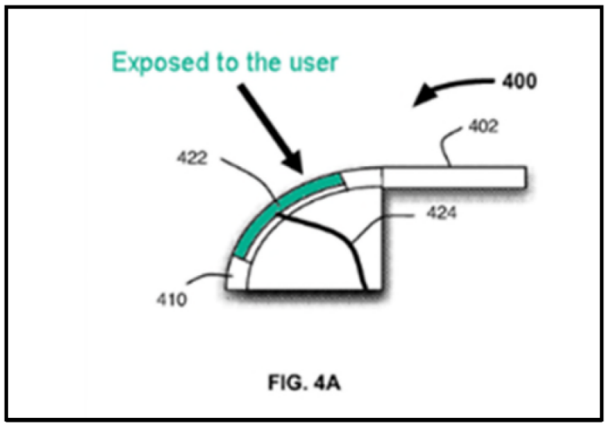


FIG. 4A

46. For the above reasons, both the descriptions contained within the '257 patent and the various other materials of which a POSITA would have been aware

indicate that the proper scope of the term "embedded in" is "at least partially set in or partially surrounded by a material" which is consistent with the plain and ordinary meaning for this term.

V. THE '257 PATENT

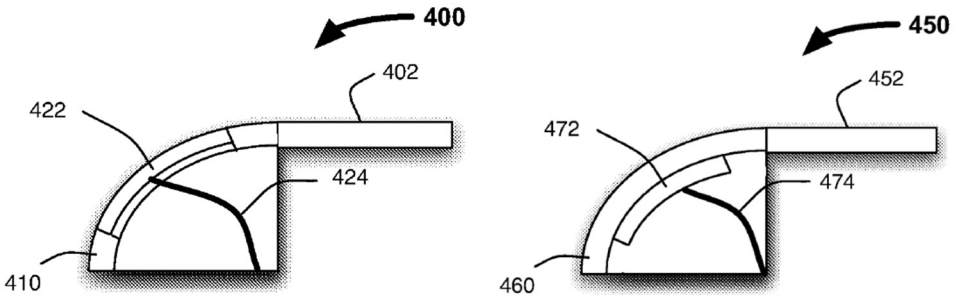
A. Overview

47. The '257 Patent is directed to an electronic device that includes a sensor for detecting a user's cardiac signal. EX1001, 2:1-2. The sensor can be used to unlock the device in response to "authenticat[ing] a user based on the attributes of the user's heartbeat." *Id*., 1:49-2:3.

48. A "heart sensor 112 can include one or more leads connected to the exterior of the electronic device." EX1001, 6:3-8. "The cardiac signals detected by the heart sensor leads can be coupled to a processor incorporated in heart sensor 112, or instead provided to processor 102." *Id*., 6:10-16. "The processor may then analyze the received signals and generate, from the received signals, one or more characteristic quantities of the user's heartbeat or heart rate for authentication." *Id*.

49. The '257 Patent provides several example configurations for its disclosed electronic device. For example, "FIG. 4A is a cross-sectional view of an illustrative electronic device having a bezel with an embedded heart sensor lead," where "lead 422 is exposed to the user." *Id*., 9:18-26. "FIG. 4B is a cross-sectional view of another illustrative electronic device having a bezel with an

embedded heart sensor lead," where lead 472 is placed "underneath the outer surface of the bezel." *Id.* 9:45-49. Each of lead 422 in Figure 4A and lead 472 in Figure 4B is coupled to a respective connector (424 and 474) that "transmit[s] the signals to a processor" of the device. *Id*., 9: 24-26, 9:51-52.



Left: '257 Patent, FIG. 4A; Right: '257 Patent, FIG. 4B

50. The '257 Patent also discloses embodiments where a lead is "embedded in or behind display 302" or "embedded in or adjacent to the housing." EX1001, 8:40-52, 10:25-29. The '257 patent provides examples of how a lead can detect the cardiac signal without needing to be a metal structure positioned on the outer surface of the device. *Id.*, 6:17-6:33. The '257 describes express benefits of an electrode that is embedded within the structure, and not forming an outer surface. *Id.*, 1:58-2:3. This includes avoiding having to perform additional authentication functions.

B. Overview of the Prosecution History

51. The application leading to the '257 Patent was filed on December 20, 2013, claiming priority to provisional application number 61/111,498 filed on

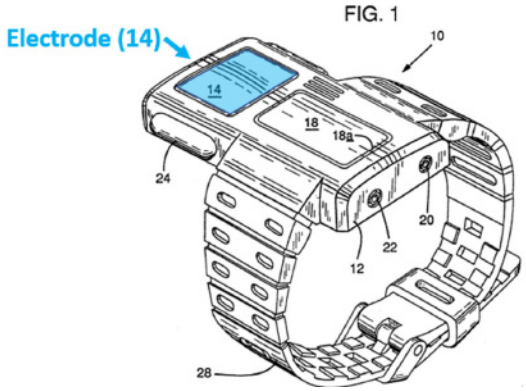
November 5, 2008 through a chain of continuation. The ’257 Patent went through an examination that involved three substantive office actions including prior art rejections based on Ceballos (US 6,522,915), Gilles (US 4,635,646), and Weiss (US 5,632,926). Subsequently, the ’257 Patent was allowed on May 22, 2018, and issued on September 18, 2018.

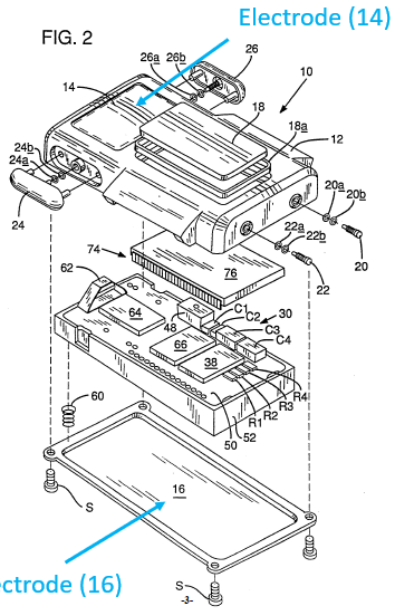
VI. OVERVIEW OF PETITIONER’S APPLIED ART

52. Petitioner has applied Mills and Markel as references in its grounds of the Petition. Below are brief descriptions of these references.

A. Mills

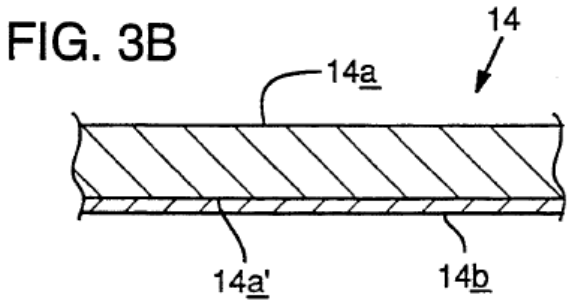
53. Mills describes a “compact, lightweight wrist-worn cardiac data and event monitor having dry skin electrodes integral with the monitor's housing .” EX1006, Abstract. As Mills describes the “extremely full function cardiac monitor … conveniently and comfortably can be wrist-worn by a cardiac patient, because the form factor and size of the monitor's housing relative to the conventional wrist band is only slightly larger than a traditional digital watch.” *Id.* 2:59-3:5. The wrist-worn device of Mills includes an upper electrode 14 that is exposed to the outside of the device to allow for direct contact by the palm of a user and a lower electrode 16 configured to contact the wrist of the user. EX1006, 4:67-5:17, 6:63-7:15, 12:13-19.





54.

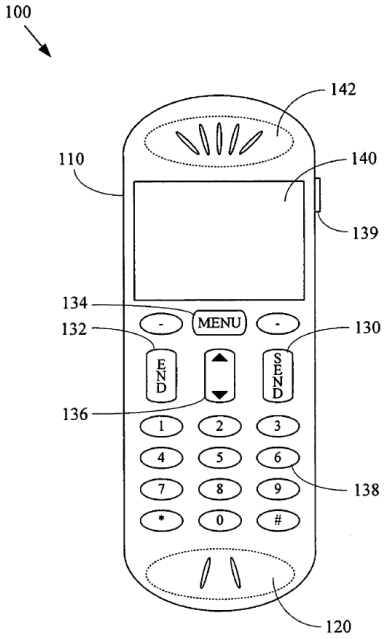
55. Both the electrode 14 and the electrode 16 are "formed of a base metal such as stainless steel" 14a with a thin outer "metal-plating" 14b that is "approximately 3-microns" thick applied as a coating on the base metal 14a "by known chemical or physical vapor deposition techniques" as shown in Figure 3B *Id.*, 3:67-4:10, 4:32-37. Mills states that the outer-plating 14b is "shown in ***greatly enlarged thickness*** in FIG. 3B relative to that of expanse 14a." EX1006, 4:4-10.



56. Mills' device includes "the functionality including the ability to produce ECG data records on demand and to play the same back to a remote site with the use only of a touch tone telephone or other suitable audio communication channel." EX1006, 7:29-45.

B. Markel

57. Markel describes a "compact, lightweight wrist-worn cardiac data and event monitor having dry skin electrodes integral with the monitor's housing."



EX1005, FIG. 1

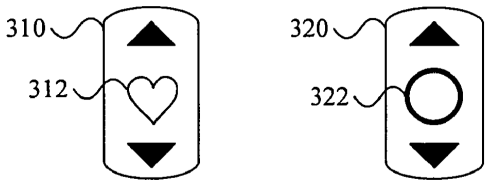
58. Markel discloses that the electrodes "generally comprise conductive material." *Id.*, [0037]. Markel then continues with providing examples of such conductive material by explaining that:

> For example, an electrode may comprise a metallic surface exposed for user contact. Also for example, an electrode may be

> formed from conductive plastic (or another material) that may be integrated into various molded components of the mobile communication device. For example, various conductive plastics (e.g., graphite-impregnated plastic or the like) may provide sufficient conductivity for an electrode to perform adequately. *Id*.

59. Markel also notes that "[e]lectrodes (or other sensors) may be shaped, positioned or formed with various physical features." *Id*., [0038]. For example, "[e]lectrodes may[] be identified for the user in any of a variety of manners or may be generally concealed from the user." *Id*., [0039].

60. To clarify what it means by an identifiable (i.e., unconcealed) versus a concealed electrode, Markel provides several examples of identifiable "electrode[s that] comprise a visible or tactile indicium to indicate the location of the electrode[s] to a user," versus concealed electrodes that "comprise molded conductive plastic with ***little or no visible indication of the electrode presence***" when "a user need not be aware of the presence of the electrode." *Id*., [0039-40]. Figure 3 depicts examples of identifiable electrodes. In Figure 3, "[f]or example, the first pushbutton 310 comprises a heart-shaped indium 312 (or other visible characteristic) to notify a user of the location of the electrode and also the function of the electrode." *Id*. "Also for example, the second pushbutton 320 comprises a circular projection (or other tactile characteristic) to notify a user of the location of the electrode." *Id*.



EX1005, FIG. 3

"In general, one or more electrodes (or other sensors) may be positioned such that the one or more electrodes ***contact*** a user during normal (or typical) use of the MCD 100." *Id*., [0041]. In FIGs. 2-6, Markel promotes placement of the electrodes ***on*** different parts of a "cellular or portable telephone" as the MCD. Such placement of the electrodes facilitate user engagement with the electrode during the use of the telephone. *See e.g.*, *id*., [0045] ("FIG. 4 provides a non-limiting example of [the] electrode placement," where "first and second electrodes may be ***disposed on*** a main body portion 110 of the MCD 100," as presented in "FIG. 4"); *id*., [0046] ("FIG. 5 provides a non-limiting example of [the] electrode placement," where the electrodes are "***disposed on*** a main body portion 110 of the MCD 100 and a pushbutton"); *id*., [0047] ("FIG. 2 provides non-limiting examples of [electrode] placement," where the "electrodes may be ***disposed on*** a same pushbutton of the mobile communication device 100"); ("FIG. 6 provides a non-limiting illustration of [electrode] placement," where "a first electrode may be ***disposed on*** a handheld portion of the MCD 100, and a second electrode may be ***disposed on*** (or proximate) an earpiece of the MCD100." "Such electrode

placement may, for example, provide for ***user contact with both electrodes*** during the process of listening to the MCD 100").

VII. ANALYSIS

I. Ground 1 Fails to Demonstrate That All Elements of Claims 1-4, 8, 10, 11, and 14 are Disclosed by Mills

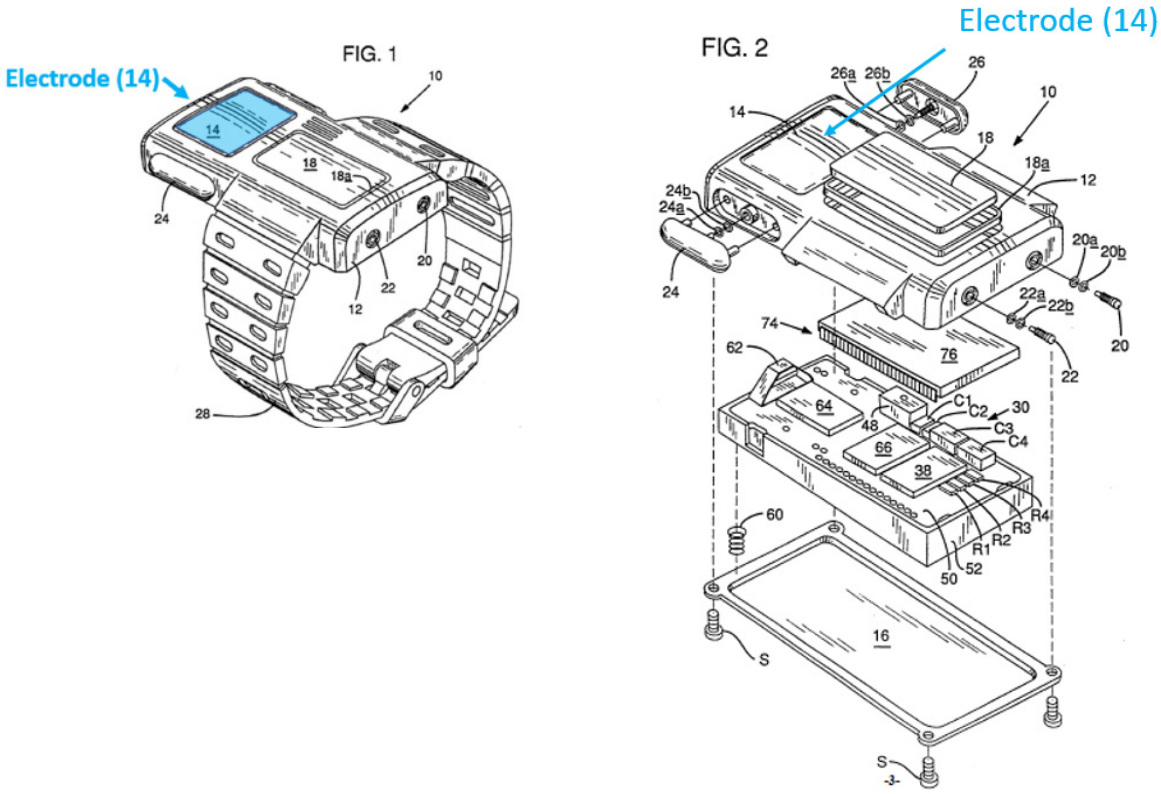
A. Masimo's Multiple Mappings of Mills to the Claims of the '257 Patent

61. Under Ground 1, both Masimo and Mr. Oslan provide a tangled collection of inconsistent mappings of the Mills reference to the "first pad" recited by claim 1. For example, Masimo and Mr. Oslan alternatively map the claimed first pad to (i) an electrode, (ii) a base metal of an electrode, and (iii) a leaf spring or a top of a leaf spring in Mills. In these examples, Masimo and Mr. Oslan fail to explain how any of the identified elements of Mills perform all of the claimed requirements of a "first pad", including the need to be "…positioned under an exterior surface of the first portion…", and "… configured to detect a first electrical signal of the user's cardiac signal…" As one example, a portion of a leaf spring is identified as "a pad" of the '257 patent primarily because Mr. Oslan insists that it is "a pad" without actually identifying how the identified portion of the leaf spring provides all of the requirements for the "first pad" recited in claim 1. In each case, as I have identified below, the identified element is not shown to meet all the requirements of the first pad, and as a result, all these mappings fail.

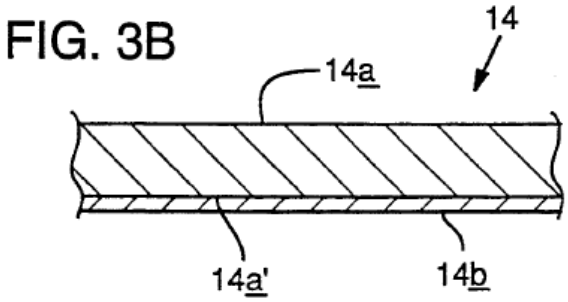
62. Even within the inconsistent mappings, Masimo and Mr. Oslan fail to properly identify elements in the prior art examples that meet all the requirements of the claims. For example, Masimo and Mr. Oslan are unable to find a structure that meets the requirements for the first pad of the first claim in any of its inconsistent mappings. Masimo finds many elements in Mills that might satisfy a portion of the requirements of this element. However, Ground 1 fails because no single component or material identified by Mr. Oslan and Masimo in any of the cited references meets all the requirements of a first pad as recited in claim 1 of the ’257 patent. In addition to these faults, there are other missing elements, which I describe below.

63. Furthermore, although Mr. Oslan presents multiple mappings for the structures identified in Mills to portions of the recitations of the claims, he does not make clear when he is switching between components of the various mappings, repeatedly jumping between different theories without identifying which particular mapping is being discussed in any particular paragraph, and in doing so, seems to be frequently mapping individual elements of Mills to multiple claim elements. This is most clear in the repetitive switching between the three different mappings of the claim term “first pad” that I mentioned above.

64. As I previously discussed in paragraph 48, the device of Mills includes an upper electrode 14 that is exposed to the outside of the device to allow for direct contact by the palm of a user. EX1006, 6:63-65, 7:13-15, 12:13-19.



65. Electrode 14 is "formed of a base metal such as stainless steel" 14a with a thin outer "metal-plating" 14b that is "approximately 3-microns" thick applied as a coating on the base metal 14a "by known chemical or physical vapor deposition techniques" as shown in Figure 3B *Id.*, 3:67-4:10, 4:32-37. Mills describes that this outer-plating 14b is "shown in ***greatly enlarged thickness*** in FIG. 3B relative to that of expanse 14a." EX1006, 4:4-10.



66. As I discussed above, the plating 14b is only three microns thick, which is much less than 1% of the likely mm-scale thickness or the cm-area dimensions of the electrode 14. *Id.*, 4:32-35. Further, a POSITA would understand that this very thin film can only be formed or further exist as a layer associated with the electrode 14a, which precludes any possibility that the electrode could be positioned relative to the film 14b, or any possibility that this film could be a portion of the housing. Mapping of the film 14b to any of the claim terms fails for these reasons.

67. As I discussed above, Masimo and Mr. Oslan present at least three mappings of the electrode 14 of Mills to the claimed features of claim 1—jumping between these various mappings without specifying which mapping is being addressed at any given time while also failing to demonstrate how any one mapping actually provides all elements of claim 1.

68. For example, M. Oslan and Masimo variously assert that

- The electrode 14 is the first pad

- The stainless steel portion 14a is the first pad
- The top of leaf spring 62 is the first pad

There are issues and missing explanations associated with the assertions that any of these three items alone meets the claim limitations required for a first pad. Making matters even more complex and incomplete, Masimo also variously and intermittently asserts that these same elements (electrode 14, stainless steel portion of electrode 14a, and top of leaf spring 62) make up the first portion of the enclosure or a first connector in the analysis of other elements of the claims. The almost unlimited interchangeability of these elements as candidates for meeting these claim terms is a consequence of the overly-broad interpretations of the meaning of these claim terms.

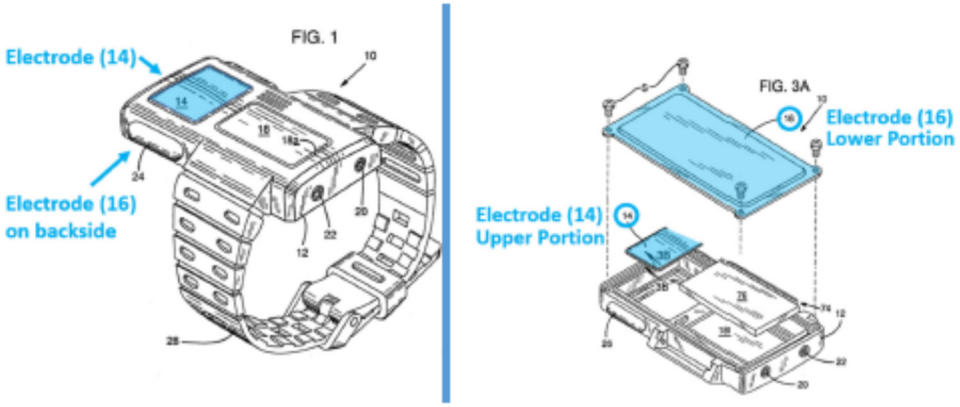
69. As a first example, it is clear from the claim language itself that Mills' electrode 14 cannot provide both the claimed "first pad" and the "first portion of the enclosure." Specifically, the claims require that the "first pad is embedded in a first portion of the enclosure," thus indicating that the first pad and the first portion of the enclosure are different structures. This is but one example of the material inconsistency in the Petition with respect to how Masimo maps the electrode 14 of Mills to claim 1. Below I present a description of the three distinct mappings of the electrode 14 of Mills to the various structures recited by claim 1 which are articulated by Mr. Oslan. Following this discussion I provide my analysis

confirming that none of the mappings proposed by Masimo and Mr. Oslan provides all elements of claim 1. This includes identifying Masimo's failure to complete the analysis of any specific mapping to the entirety of the claims.

70. In addition to, and in accordance with, these inconsistent mappings in the Petition, Masimo also provides inconsistent mappings as to which disclosures of Mills provide the claimed "enclosure," once again switching between different mappings throughout its analysis of claim 1 without clear indications of which mapping is being discussed in any given section. These inconsistent mappings of Mills to the claimed enclosure are also detailed below.

1. Masimo's First Mapping of Mills' Electrode 14 to Claim 1 (Electrode 14 is the claimed "first pad")

71. Mr. Oslan provides his first mapping of Mills' electrode 14 early in his analysis of claim 1 under what he has identified as Limitations 1[b(i)-(v)]. EX1003, ¶59. In this first mapping, Mr. Oslan identifies the entire electrode 14 (including the stainless steel portion 14a and the deposited film 14b) as the claimed "first pad," referring to "first pad 14." EX1003, ¶59 (pages 26-27). For example, Mr. Oslan states that "Electrodes 14 and 16 are both on the outer surface of the device housing and therefore are the pads described in the '257 patent." *Id*. Mr. Oslan states that "Fig. 1 of Mills shows a first pad 14" followed by annotated versions of Figures 1 and 3A.



EX1003, ¶59 (page 28).

72. After this discussion in his paragraph 59, Mr. Oslan switches between the second and third mappings (discussed below) before ultimately returning to this first mapping in addressing Limitation 1[c]. Specifically, Mr. Oslan states that "Electrodes 14 and 16 are both thin mats that are part of the electrical path of a lead and are therefore pads." EX1003, ¶65. This statement from Mr. Oslan once again makes it clear that in this mapping he is equating the electrode 14 to the claimed first pad.

73. The Petition repeats this mapping made by Mr. Oslan, for example, when addressing these claim elements in the Petition, Masimo states that "Mills discloses ***a first pad - electrode 14***." Pet., 19. The Petition continues this mapping in the analysis of element 1[b(ii)], stating "Mills discloses its ***electrode 14 (first pad)***." *Id.* In articulating this mapping, Masimo also identifies that it is mapping electrode 14 to the claimed first pad, not the claimed enclosure, by stating that

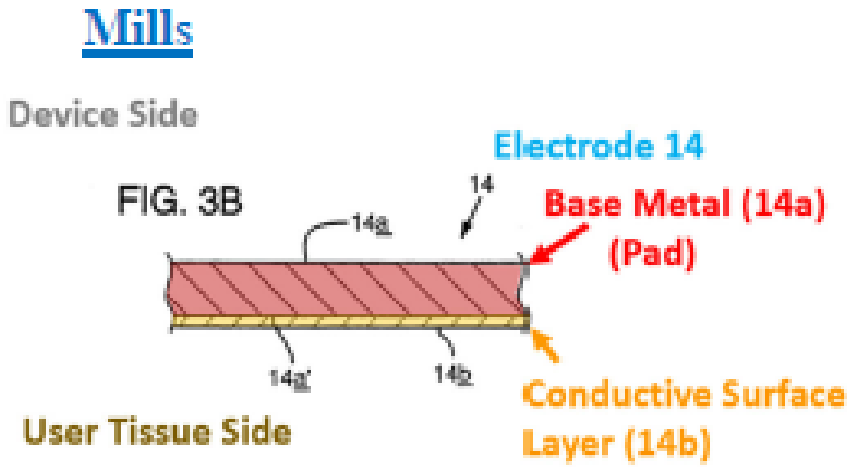
"electrodes, 14 and 16 [are] located on different portions of the enclosure." Pet., 20. Based on these assertions made by both Mr. Oslan and Masimo, the first mapping reads the entire electrode 14 (including both the layers of electrode 14 discussed above) as the first pad recited in claim 1.

74. After switching from this mapping to at least two alternative mappings of the electrode 14 to claim 1 (discussed below), Masimo returns to this initial mapping in addressing element 1[b(v)], stating "the ***electrode 14 (pad)*** of Mills is configured to detect a first electrical signal of the user's cardiac signal." Pet., 26. Then, in addressing element 1[b(vii)], Masimo refers to Mills' electrode 14 as "first lead 14," indicating that in this mapping, the entire electrode 14 is considered part of the claimed "first lead" rather than part of the claimed enclosure. Pet., 29. Masimo continues this first mapping in element 1[c(i)], stating that "leaf spring 62 is a first connector coupling electrode 14 (first pad) to the processor of Mills." Pet., 31.

2. *Masimo's Second Mapping of Mills' Electrode 14 to Claim 1 (stainless steel base layer 14a is the "first pad" and metal-plating layer 14b is the "first portion of the enclosure")*

75. After presenting his first theory in which the electrode 14 (including both layers 14a and 14b) provides the claimed "first pad" that is embedded in the first portion of the enclosure, Mr. Oslan appears to adjust his mapping to a second mapping in which only the stainless steel base layer 14a of the electrode 14 reads

on the claimed "first pad." EX1003, ¶59 (pages 28-29). This is shown, for example, in the annotated version of Figure 3B that Mr. Oslan includes on page 29 of his declaration.



EX1003, ¶59 (page 29)

76. As shown in this annotated version of Figure 3B, Mr. Oslan clearly identifies the stainless steel base metal layer 14a as a "pad" (presumably reading this layer 14a on the claimed "first pad" in light of the earlier discussion of paragraph 59). However, Mr. Oslan does not identify what portion he believes to be the claimed "first portion of the enclosure." He does, however, make this distinction a page earlier, identifying that "[p]lating of an outer, skin-contactable region" provides the claimed "first portion." EX1003, ¶59 (page 28). Thus, in this second mapping, Mr. Oslan now appears to identify the three-micron thick outer-

plating layer 14b with the claimed "first portion of the enclosure" and the stainless steel base metal layer 14a as the claimed "first pad." EX1006, 3:67-4:10, 4:32-35. I note that after this brief discussion on pages 28 and 29, Mr. Oslan does not appear to return to this second mapping. I also note that earlier when addressing Limitation 1[a] ("an enclosure"), Mr. Oslan does not refer to any part of the electrode 14 as providing part of the enclosure. EX1003, ¶57. He identifies only the housing 12 as providing the claimed enclosure. *Id.* Mr. Oslan's declaration does not appear to make any attempts to reconcile this inconsistency between the two mappings.

77. The Petition once again follows this abrupt switch in the mapping of Mills to claim 1. For example, in addressing element 1[b(ii)], Masimo shifts from its initial mapping of the entire electrode 14 to the claimed first pad to instead identify "this first pad" as "electrode 14a." Pet., 19, 22. As part of this shift in mapping Mills to claim 1, Just as Mr. Oslan did in his declaration, the Petition asserts that "the exterior surface 14b" constitutes "the first portion of the enclosure." Pet., 22. Similar to Mr. Oslan's declaration, Masimo does not identify any portions of the electrode 14 as being part of the enclosure when addressing element 1[a]. *Id.*, 16. I note that Masimo's petition (and Mr. Oslan's declaration) switch between the first mapping and the second mapping in addressing the same element (element 1[b(ii)] in the petition) without identifying these two different

interpretations of Mills as separate or alternative mappings to the claims. Pet., 19-22.

78. Masimo appears to continue this second mapping in its discussion of element 1[b(iv)]. In the first paragraph of its discussion of element 1[b(iv)], it is unclear which of the first two mappings Masimo is relying on as it does not specifically identify any particular structure of Mills as corresponding to the claimed "first portion of the enclosure" even though this claim element recites "the first pad is positioned underneath the exterior surface ***of the first portion***." Pet., 24. Although not clear, it appears that Masimo is implicitly relying on its second mapping of the electrode 14 to claim 1 as it refers to expanse 14a and outer-coating 14b separately, stating "embedded lead 14a is underneath or covered by the exterior surface 14b." *Id.* Once again, Masimo does not distinguish this mapping from the first mapping discussed above, and in doing so, fails to complete its first mapping. By failing to identify the required "exterior surface of the first enclosure" for the first mapping, the first mapping fails at this element, as I discuss in greater detail below. As with Mr. Oslan's declaration, after the analysis of element 1[b(iv)], the Petition appears to abandon this particular mapping for the remainder of the claim 1 analysis. The Petition only briefly returns to this mapping in the analysis of claim 8, stating that "[h]ousing 12 and outer surface portion 14b

of electrode 14 form a pocket into which the inner base metal pad portion 14a underneath the exterior surface 14b of the enclosure." Pet., 37.

3. *Masimo's Third Mapping of Mills' Electrode 14 to Claim 1 (the entire Electrode 14 is the claimed "first portion of the enclosure" and the top of Mill's leaf-spring 62 is the claimed "first pad")*

79. After shifting between the first two mappings, discussed above, in his analysis of Limitations 1[b(i)-(v)], Mr. Oslan presents a third mapping of Mills to the claims, identifying the top of the trapezoid-shaped leaf spring 62 as "a pad" and the electrode 14 as providing an "Upper (First) Portion." EX1003, ¶60. Specifically, Mr. Oslan states that "[t]he top of the trapezoid-shaped leaf spring 62 is a pad." *Id.* Notably,

80. In its third mapping of Mills to Claim 1, Masimo states that "[t]he top of the trapezoid-shaped leaf spring 62 is a pad" while addressing element 1[b(ii)] and therefore appears to map the top of leaf spring 62 to the claimed first pad. Pet., 23. He follows this discussion with a reproduction of a portion of Figure 2 of Mills showing the leaf spring 62.

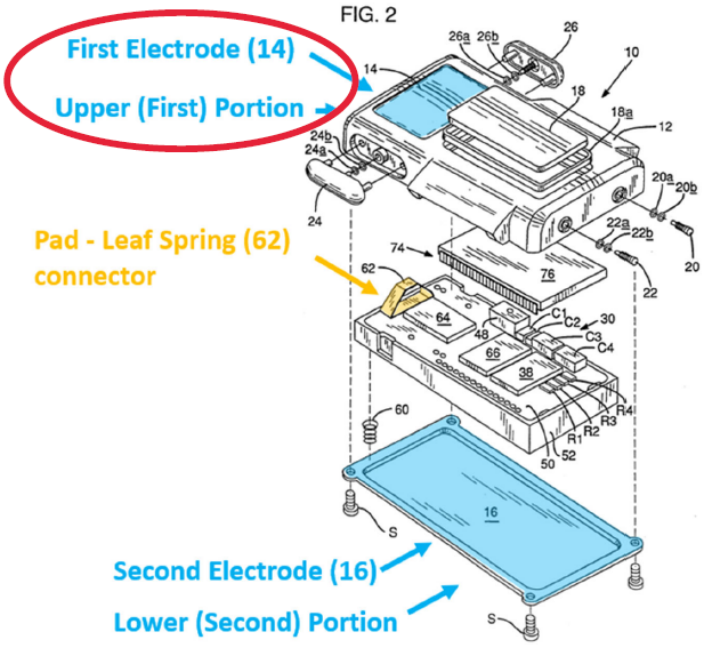
EX1003, ¶60 (page 30).

81. I note that Mr. Oslan never expressly states in his declaration that the top of the leaf spring 62 is the claimed "first pad." Rather, he only ever identifies this portion of the leaf spring as "a pad." EX1003, ¶60. I have reviewed Mr. Oslan's deposition transcript and found that he seemed to go out of his way to avoid classifying this portion of the leaf spring 62 as the claimed "first pad" when asked directly if this portion of the leaf spring was a first pad on multiple occasions. APPLE-2008, 43:5-45:2, 46:13-49:7. When further pressed on this question, Mr. Oslan did not assert that the portion of the leaf spring was the first pad:

> Q. Does the top of the trapezoid-shaped leaf spring 62 provide all requirements for the first pad recited by Claim 1?
> MR. EVERTON: Objection to form.
> THE WITNESS: So, again, I'd have to go back and do an analysis of that, and I can't answer that at this time.

APPLE-2008, 48:22-49:6. Oslan's evasive analysis and reluctance to state that this portion of the leaf spring is a "first pad" in this third mapping therefore fails. Mr. Oslan simply has not expressly identified how he believes that the top portion of the leaf spring 62 provides all requirements for the first pad recited in claim 1, and avoids stating otherwise, even when given multiple opportunities to do so.

82. Prior to his identification of the leaf spring 62 as "a pad," Mr. Oslan identifies that in this alternative, third mapping, he is reading the electrode 14 on the claimed "first portion of the enclosure."



EX1003, ¶60 (page 30).

83. The Petition once again repeats this third mapping described in Mr. Oslan's petition, using almost the exact same language. Pet., 22-25. For example, Masimo describes this third mapping, stating "electrode 14…is a first portion

forming part of the exterior surface of Mills" and referring to "***electrode 14 (first portion)***." Pet., 24.

84. As I discussed above with respect to Masimo's second mapping, this third mapping is inconsistent with Masimo's analysis of element 1[a]. Specifically, in addressing element 1[a] ("an enclosure"), Masimo does not identify any portion of electrode 14 as making up a part of the enclosure. Pet., 16-17; EX1003, ¶57. Rather, both Mr. Oslan and Masimo expressly identify ***only the housing 12*** of Mills as providing the claimed enclosure. *Id.*

4. Masimo's Inconsistent Mapping of Mills to the Claimed "enclosure" of Claim 1

85. In accordance with the above described inconsistent mappings of the electrode 14 of Mills to Claim 1, both Mr. Oslan's declaration and Masimo's Petition present inconsistent mappings as to which structures in Mills provide the claimed "enclosure" of Claim 1 (Element 1[a]). As discussed above, in addressing element 1[a], Masimo identifies only the housing 12 as providing the claimed "enclosure." Pet., 16-17; EX1003, ¶57. Mr. Oslan states in his paragraph 57, "As shown below in Fig. 1 of Mills, Mills discloses an electronic device 10 for detecting a user's cardiac signal. EX1006, Fig. 1 (reproduced in part, below), 3:7-8. The device 10 includes a housing or enclosure 12. *Id.*" EX1003, ¶57. With respect to claim element 1a, there are no other mappings from any other elements or

structures in Mills to the term "an enclosure". Only the "housing 12" of Mills is identified as the claimed enclosure. This is consistent with Masimo's first mapping of the electrode 14 to claim 1 in which the entire electrode 14 is mapped to the claimed first pad.

86. However, as part of Masimo's second mapping of the electrode 14 to claim 1, which is first presented within the discussion of limitation 1[b(ii)], Masimo departs from the mapping discussed with respect to element 1a, and relies on a new arrangement which maps "the exterior surface 14b" of electrode 14 to "the first portion of the enclosure." Pet., 22. This new proposal in limitation 1[b(ii)] appears to depart from the already stated mapping in this ground of housing 12 to the claimed "enclosure" by newly adding the outer-platting 14b of electrode 14 to the claimed housing and asserting that this is part of the enclosure. Pet., 22; EX1003, ¶59. As discussed above, Masimo and Mr. Oslan do not identify this mapping as a complete and distinct alternative to the first mapping but rather conflates the two throughout his analysis.

87. Finally, in this same section analyzing claim term 1[b(ii)], Masimo provides a new mapping in which the leaf spring 62 of Mills is a "pad" (not a "first pad"), and all of electrode 14 becomes the first part of the enclosure, by identifying the entire "electrode 14" as "a first portion forming part of the exterior surface of Mills," thereby appearing to map all of electrode 14 to the claimed first portion of

the enclosure. Pet., 24; EX1003, ¶60. Nowhere in the analysis of limitation 1[b(i)] does Masimo or Mr. Oslan specifically mention the possibility that the "pad" at the top of the leaf spring in Mills can be the "first pad" of the '257.

88. Summarizing the structure of the mappings offered by Mr. Oslan and Masimo:

- In element 1[a], the housing 12 of Mills is an "enclosure".
- In element 1[b(i)], the entire electrode 14 is a "first pad".
- In element 1[b(ii)],
    - the entire electrode 14 is a pad, "embedded in" the housing 12
    - or, the stainless steel portion 14a of electrode 14 is a pad, and the thin film portion 14b of electrode 14 becomes part of the housing. The stainless steel portion 14a of electrode 14 is embedded in the housing and the thin film portion 14b of the electrode 14
    - or, the entire electrode 14 is part of the housing, and the pad of the leaf spring is a pad. This is possibly a "first pad", but Masimo and Mr. Oslan do not make this assertion in this section.
- In element 1[b(iii)],

- electrode 14 is an exterior surface of the first portion of the enclosure
- or, the thin film 14b is an exterior surface of the first portion of the housing

89. Throughout all of this, which is not even the complete analysis of claim 1, there is no clear connection between each of the individual assertions about the mapping of elements to claim terms that would comprise a complete mapping of a single set of elements to the elements of the entire claim. In the section above, I've presented the mappings for just 4 of the claim terms, and even in this limited set, there is no consistent combination throughout just these 4 terms that can meet these limitations. Specifically, if the housing 12 is an "enclosure" and the electrode 14 is a "first pad", most of the choices for the third and fourth claim terms are not available as they have already been mapped to one of these first two elements. Of those that remain, there are none that can simultaneously meet the first 3 claim terms or all 4 of these claim terms.

90. In light of these additional inconsistencies, it becomes apparent that Mr. Oslan does not provide a single coherent theory of how Mills provides a single mapping to claim 1 that meets all of the requirements of claim 1. Specifically, no single mapping provides the claimed "first pad" in a manner that meets all of the requirements for the first pad as recited in claim 1.

B. Masimo and Mr. Oslan Fail to Identify How Any Mapping from Mills Meets All Requirements of Claim 1

91. As I discussed above, Mr. Oslan and Masimo assert three distinct mappings of Mills to claim 1, including the three distinct assertions that:

- The electrode 14 is the first pad
- The stainless steel portion 14a is the first pad
- The top of leaf spring 62 is the first pad or simply "a pad"

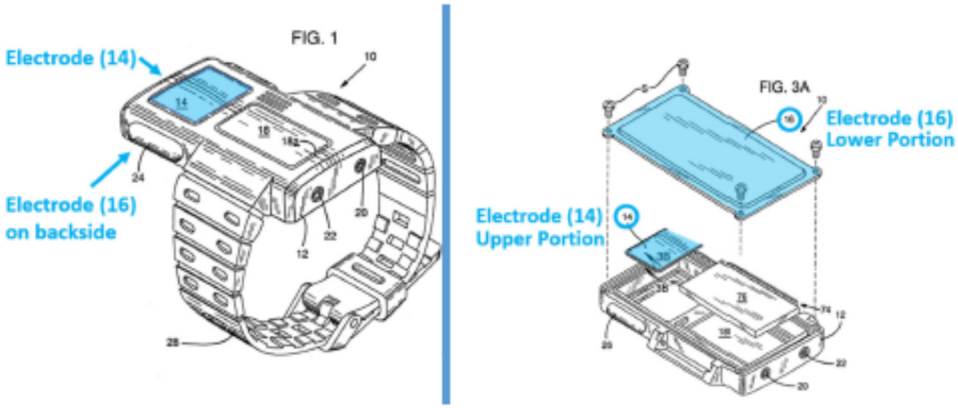
92. There are issues and missing explanations associated with the assertions that any of these three items alone meets the claim limitations required for a first pad. This includes a failure by Masimo to even address every element of claim 1 based on any single consistent mapping. Below, I walk through each of Masimo's three mappings and point out various faults, demonstrating that none of the mappings provides all elements of claim 1.

1. *Masimo's First Mapping of Mills to Claim 1 Fails to Provide All Requirements for the Claimed "first pad" for Electrode 14.*

93. As I previously discussed, Mr. Oslan and Masimo's Petition present a first mapping of Mills to claim 1 in which they identify the entire electrode 14 (including both base layer 14a and outer-plating 14b) as providing the claimed "first pad" which makes up at least part of the "first lead." EX1003, ¶59; Pet., 18-20, 26, 29. However, this mapping fails to provide all recitations of claim 1 because the electrode 14 is not both "embedded in a first portion of the enclosure"

and "positioned underneath the exterior surface of the first portion" as required by claim 1. The failure of the electrode 14 to meet all requirements for the claimed "first pad" is clear because the upper surface of the electrode 14 is exposed to the outside of the device and is therefore not "positioned underneath the exterior surface of the first portion" as required by claim 1.

94. For example, in presenting his first mapping of Mills to claim 1 as part of his analysis in paragraph 59, Mr. Oslan includes a reproduction of Figure 1 of Mills with the electrode 14 labeled, clearly showing that the electrode 14 is exposed to the outside of the device, and therefore definitely not "positioned underneath" the housing 12. EX1003, ¶59 (page 28).



EX1003, ¶59 (page 28).

95. Masimo's first mapping therefore fails to provide all requirements recited in claim 1 for the first pad because the electrode 14 is not positioned underneath an exterior surface of the housing 12. Both Mr. Oslan's analysis itself and the analysis of element 1[b(iv)] support this conclusion as both Mr. Oslan and

Masimo abandon this first mapping completely, including only analysis of its second and third mappings when discussing the claimed requirement that "the first pad is positioned underneath the exterior surface of the first portion" of the enclosure. *See* EX1003, ¶59; Pet., 24-25.

96. At various points in the petition, when describing other mappings of Mills to claim 1, Masimo asserts that the electrode 14 is the claimed first portion of the enclosure. *See* Pet., 22-23. Mr. Oslan also makes such assertions in his declaration. EX1003, ¶60. However, within a single complete mapping of claim 1, the electrode 14 of Mills cannot simultaneously be both the first pad and the first portion of the enclosure in which the first pad is embedded and which the first pad is "positioned underneath" as required by the claims. A POSITA would recognize that a single structure in Mills cannot simultaneously serve as 2 claimed structures. Further and more obviously, a POSITA would recognize the straight forward fact that a component cannot be positioned underneath itself. Logic also indicates that the electrode 14 cannot read on both the claimed first pad and the first portion of the enclosure because it is physically impossible for the electrode 14 to be embedded in and positioned underneath itself.

97. As shown in Figure 1 of Mills, above, the electrode 14 is exposed to the outside of the device and therefore, in Masimo's first mapping of Mills to claim 1 in which the electrode 14 is mapped to the claimed "first pad" and the housing 12

is mapped to the claimed enclosure. Therefore, Mills fails to disclose that "the first pad is positioned underneath the exterior surface of the first portion" of the enclosure because the electrode 14 is not positioned underneath an exterior surface of the housing 12. Masimo's first mapping therefore fails to provide all requirements for the claimed "first pad."

98. Based on the reasoning I've discussed above, Masimo's first mapping also fails to provide Limitation 1[b(v)] which requires detection "of the user's cardiac signal via the user's skin's contact with the exterior surface ***of the first portion of the enclosure***." As I discussed above, in this first mapping, Masimo and Mr. Oslan identify the electrode 14 as the first pad and the housing 12 as the first portion of the enclosure. However, the housing 12 in Mills is formed from a non-conductive plastic. EX1006, 6:40-45. Therefore, it is impossible for the user's cardiac signal to be detected "via the user's skin's contact with the exterior surface ***of the first portion of the enclosure***" in this mapping because the housing 12 is non-conductive. Mr. Oslan agreed during his deposition that contact with the housing alone was insufficient for Mills' device to detect the user's cardiac signal. APPLE-2008, 65:8-67:7.

A. Masimo's Second Mapping of Mills to Claim 1 Fails to Provide All Requirements for the Claimed "first pad" with Respect to Stainless Steel Portion 14a

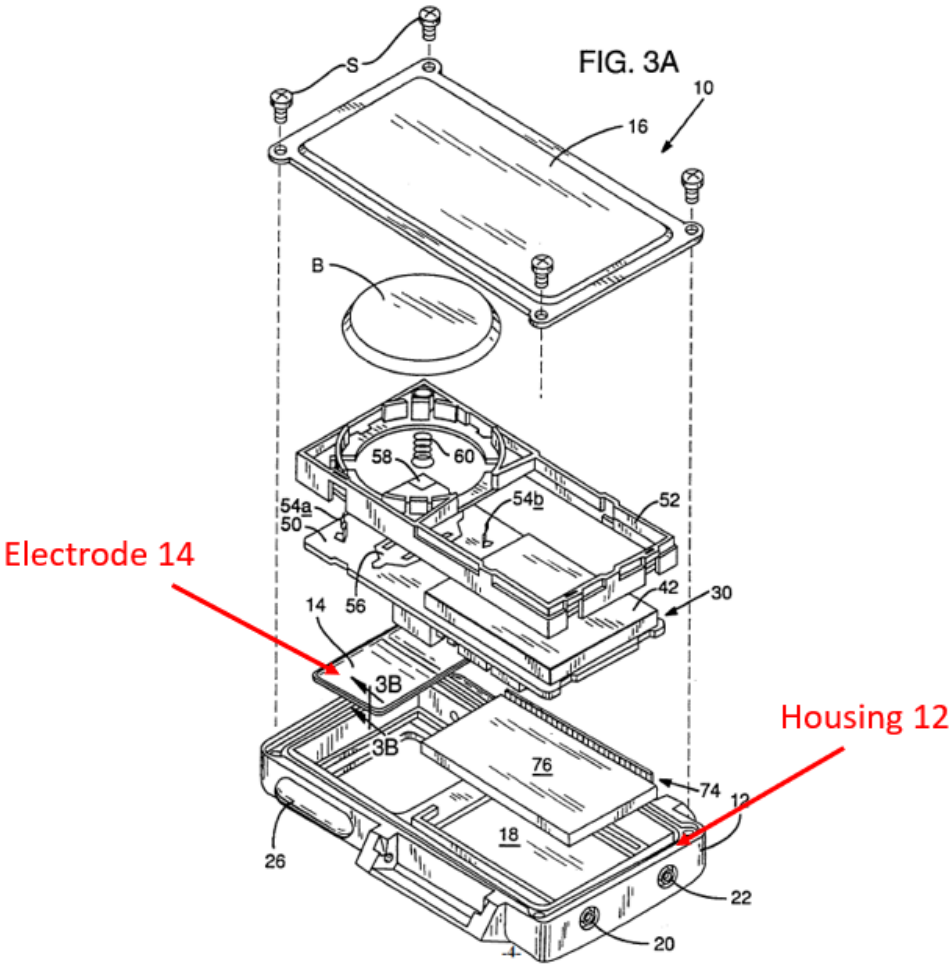
99. There are at least three faults with Mr. Oslan and Masimo's second mapping of Mills to claim 1 that each independently demonstrate that the second mapping fails to provide all elements of claim 1, including all requirements for the claimed "first pad." These faults are

- The outer plating 14b of electrode 14 is not a part of the housing/enclosure of Mills' device but rather, an imperceptibly thin coating deposited/plated on the main electrode expanse 14a.
- The main electrode expanse 14a of electrode 14 is not "embedded in" the outer plating 14b but is merely positioned adjacent to the outer plating 14b.
- Third, the disclosures of Mills do not support Masimo's second mapping.

100. As I previously discussed, in Masimo's second mapping, Masimo alleges that the stainless steel expanse 14a of the electrode 14 reads on the claimed "first pad" and that the three-micron thick metal-plating composition 14b reads on the claimed "first portion of the enclosure." *See* Pet., 22, 24. Below I address each reason that demonstrates that this second mapping fails to provide all elements of claim 1 and is also not supported by the actual disclosures of Mills.

a. Mills' "metal-plating composition 14b" is not part of the enclosure separate from base metal layer 14a

101. Turning to the first reason that Masimo's second mapping fails to disclose elements 1[b(ii)] and 1[b(iv)], the outer plating 14b of electrode 14 is not and cannot conceivably be considered a portion of the housing or enclosure of Mills' apparatus 10. As a POSITA would have recognized, the metal-plating composition 14b that forms a three-micron thick outer coating on the base metal layer 14a is not a separate component from the base layer 14a that can form a part of the enclosure, distinct from the base metal layer 14a. Rather, the metal-plating composition 14b of Mills electrode 14 is an imperceptibly thin coating "plated" on the main expanse 14a of electrode 14 "by known chemical or physical vapor deposition techniques." EX1006, 4:32-39. A POSITA would know that it is impossible to grow a film by chemical or physical vapor deposition methods on it's own. Such growth requires a substrate (in this case the stainless steel section 14b), and a POSITA would know that it is impossible to remove an intact thin film from the substrate. As shown in Figure 3A, after this outer coating is plated on the electrode 14, the electrode is affixed to the housing 12.



EX1006, FIG. 3A (annotated)

102. The metal-plating composition 14b is not a portion of the housing/enclosure that the expanse 14a is "embedded in" as required by the claims, but rather, the metal-plating composition 14b is a thin layer plated on the main body of electrode 14 ("expanse 14a") using "known chemical or physical vapor deposition techniques." EX1006, 4:32-39. A POSITA would have readily understood that the base metal layer 14a is not "embedded in" the outer metal-plating layer 14b which is created through depositing the material on the base layer

14a itself. The dual layered configuration of electrode 14, in which the metal-plating layer 14b is coated on the base layer, simply does not fall within any reasonable interpretation of the claim language requiring that the first pad be "embedded in" the first portion of the enclosure.

103. I also note that, Figure 3B is not drawn to scale. Mills expressly states that "composition 14b [is] ***shown in greatly enlarged thickness*** in FIG. 3B relative to that of expanse 14a." EX1006, 4:4-7. A POSITA would have known that a metal-plating layer would not have the structural integrity to stand alone as a portion of the enclosure of Mills. This is particularly true because Mills gives express dimensions for the outer plating 14b, disclosing that it is "approximately 3-microns (0.003-inc) thick." EX1006, 4:32-35. Three microns is an imperceptibly thin thickness for such a coating layer, having less than a sixtieth of the thickness of a sheet of paper.

104. A POSITA would have understood that 3-micron thin films, such as that described by Mills, are usually deposited by Chemical or Physical Vapor Deposition processes, which are carried out at high temperature and under low pressure. These deposition processes are explicitly disclosed by Mills and are very common in electrical circuit manufacturing processes and are also widely used in high-volume metal finishing processes. A POSITA would understand that these processes are usually carried out at high temperatures (250C to 450C). After

cooling, these films are usually under compressive stress as the underlying substrates undergo more thermal contraction when cooled to room temperature than the PVD films. As a result, if these films are to be somehow released from the underlying substrate and considered as a free-standing element, there is usually buckling, peeling and cracking. A POSITA would expect that free-standing micron-thick films of TiN, TiC and TiCN are always cracked and broken into small pieces. One would never attempt to create such a film, consider it to be a portion of an enclosure, and then attach other structures to it.

105. An important note – the claims require that the pad is to be "positioned underneath the exterior surface of the first portion." This language requires that the pad and the first portion are separate structures and that the first pad is to be positioned underneath the first portion. A POSITA would understand that the thin film of Mills is not capable of existing as a free-standing entity, and the first pad cannot be positioned relative to it, as the act of being "positioned" requires that the electrode 14A be moveable relative to the 3-micron film 14B. As Mills describes, this 3-micron film is grown or deposited on the metallic electrode. It does not exist separate from the electrode. A POSITA would know that there is no opportunity or possibility to position the base electrode layer 14a relative to the film 14b.

106. Therefore, this second mapping fails at least because the 3 micron thick layer on the electrode is not a portion of the enclosure, and the pad cannot be positioned beneath this three micron film. There is no reasonable interpretation of Mills under which a POSITA would have considered the outer plating 14b of electrode 14 to be a portion of the enclosure distinct from the electrode 14a. A POSITA would have understood that Mills' coating 14b cannot stand alone to form a portion of the housing 12 in the absence of the main body of electrode 14. Indeed, Mills' disclosure is consistent with description provided by the '257 Patent, which also applies "a conductive coating" ***to its leads*** as opposed to the enclosure of the device. EX1001, 9:4-13. A three-micron thick coating, applied to a component that Masimo does not allege is part of the housing/enclosure in this second mapping, if affixed to the housing 12 on its own, separate from the expanse 14a, would not have the structural integrity to support other components or even retain its own structure without immediately shattering. It would have been clearly understood by a POSITA that Mills' coating 14b was part of the electrode, not part of its enclosure.

107. Even ignoring the expressly disclosed thickness of Mills' outer plating 14b, interpreting claim 1's recitations of "an enclosure" and a distinct "first pad that is embedded in a first portion of the enclosure" to read on a multi-layered electrode (as Mr. Oslan and Masimo have done here) stretches the meaning of

claim 1 beyond any reasonable interpretation. In my opinion, the claims mean what they say, the claimed electronic device includes "an enclosure" and a separate "first pad that is embedded in a first portion of the enclosure." Mills' multi-layered electrode 14 having a main expanse 14a and a three-micron thick "metal-plating composition 14b" is exactly what Mills describes it as: a multi-layered electrode, not an enclosure and separate first pad embedded in the enclosure.

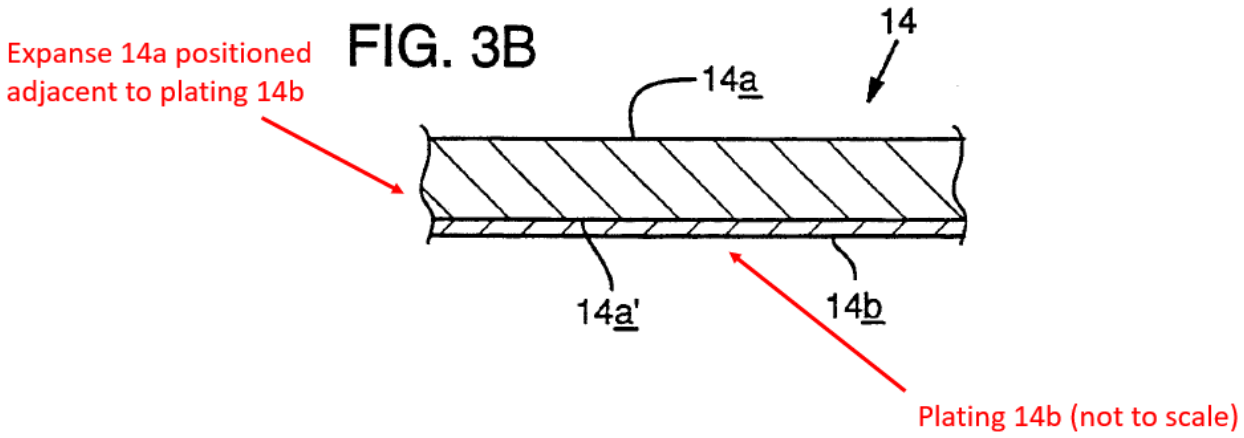
b. The base metal layer 14a is not "embedded in" the "metal-plating composition 14b"

108. Turning to the second reason that Masimo's second mapping fails to disclose elements 1[b(ii)] and 1[b(iv)], even if the metal-plating composition 14b of electrode 14 is considered to be part of the enclosure and the base metal layer 14a of electrode 14 is considered a separate "first pad" (an improper reading of Mills' disclosures, as discussed in the previous section), the base metal layer 14a is not "embedded in" metal-plating composition layer 14b and therefore Mills fails to disclose element 1[b(ii)] under Mr. Oslan and Masimo's second mapping of Mills to claim 1.

109. As discussed in the claim construction section, above, the proper scope of the plain and ordinary meaning of the term "embedded in" is "at least partially set in or partially surrounded by a material." As discussed above in the claim construction section, the specification of the '257 patent draws a clear

distinction between leads that are "embedded in" a housing and leads that are embedded "adjacent to the housing." EX1001, 10:24-29, 9:44-48 (differentiating between a lead that is "positioned against" an inside surface of the housing and a lead that is embedded "within the thickness of" the housing.) I also identified that Masimo advocated for an even narrower construction for the term "embedded in" in the district court of "set firmly into and surrounded by material." APPLE-2004, 57. Masimo and Mr. Oslan's second mapping fails to satisfy all requirements for the "first pad" of claim 1 under either the proper definition of "embedded in" or Masimo's more narrow district court definition. This is because the base metal layer 14a is not "at least partially set in or partially surrounded by" the metal-plating layer 14b nor is the base metal layer 14a "set firmly into and surrounded by" the metal-plating layer 14b. This is because Mills makes clear that the layers 14a and 14b are simply two parallel layers of a multi-layered electrode, with neither layer partially surrounding the other.

110. As demonstrated by Figure 3B, the base metal layer 14a of electrode 14 is not "embedded in" the metal-plating composition 14b. Instead, Figure 3B shows that the two layers 14a and 14b are positioned parallel each other, with neither layer surrounding or encompassing the other, either in part or in whole.



EX1006, FIG. 3B, 3:67-4:10, 4:32-39.

111. The specification of Mills further discloses that the base metal layer 14a and metal-plating composition 14b are parallel surfaces positioned such that the expanse 14a is in adjacent, parallel contact with the metal-plating composition 14b rather than embedded in the metal-plating composition 14b. For example, Mills describes the composition 14b as "[p]lating an outer, skin-contactable region or surface 14a' of expanse 14a." EX1006, 4:4-10. Mills go on to describe that this "metal-plating composition 14b" is plated on the base metal expanse 14a "by known chemical or physical vapor deposition techniques." *Id.*, 4:32-39. These descriptions of a thin plating layer deposited over the base metal layer make clear that the base metal layer 14a is coated with a parallel layer 14b and not embedded in the layer 14b. Mr. Oslan agreed with this characterization of Mills, stating "I don't see anything in Mills explicitly saying that 14a is embedded in 14b." APPLE-2008, 58:22-62:1. Consistent with my analysis of the descriptions and

figures of these two layers 14a and 14b, Mr. Oslan also stated that the two layers are flat and that "it appears 14b is parallel to 14a." *Id.*, 59:11-15. Mr. Oslan additionally confirmed that Mills "doesn't show that 14b surrounds 14a." *Id.*, 61:12-17. Further, as discussed above, Mr. Oslan's understanding of the meaning of the term "embedded" excludes situations where a first structure with flat surface being positioned below a second structure with a flat surface, as the second structure is not "an integral part of" the first structure.

112. I have reviewed all of Mills and it contains no disclosure of the base metal layer 14a of electrode 14 being "at least partially set in or partially surrounded by" or "set firmly into and surrounded by" the metal-plating composition 14b. Therefore, in addition to the reason I described in the previous section, the second mapping of Mills to claim 1 presented by Mr. Oslan and Masimo fails to disclose "a first lead comprising a first pad ***embedded in*** a first portion of the enclosure" as required by claim 1.

c. The disclosure of Mills does not support the second mapping presented by Mr. Oslan and Masimo

113. In addition to the above two reasons that the second mapping presented by Mr. Oslan and Masimo fails to provide all elements of claim 1, this second mapping also fails because the actual disclosures of Mills simply do not support Masimo's characterization of the second mapping. It is therefore my

opinion that all arguments based on this second mapping should be disregarded as irrelevant as to if Mills actually discloses the features of the challenged claims.

114. As I discussed above, Mr. Oslan's discussion of this second mapping is rather brief, taking up only a portion of paragraph 59 of his declaration. His analysis for this second mapping is also confusing because he uses the shortened term "first portion" rather than expressly identifying a "first portion of the enclosure" for this mapping. However, the fact that he discusses the multi-layered configuration of electrode 14 before asserting that "the pad (base metal 14a) is positioned underneath the exterior of the first portion" at least suggests that he is mapping the metal-plating layer 14b to the claimed fist portion of the enclosure. EX1003, ¶59 (page 28).

115. However, earlier in paragraph 59, on page 27, Mr. Oslan appears to suggest that the outer plating 14b is part of the enclosure based on Mills statement that electrode 14 is "integrally molded" in housing 12. EX1003, ¶59 (page 27) (citing EX1006, Fig. 1; 3:48-49). In my opinion, this simple disclosure that the electrodes 14 and 16 are "integrally molded" does not, without more detail, indicate whether or not the electrodes are "embedded in" the housing 12. That being said, if this disclosure of Mills provides the basis for Mr. Oslan's opinion regarding all or a portion of the electrode 14 being part of the enclosure, it either demonstrates that ***all*** of the electrode 14 (i.e., both layers 14a and 14b) are part of

the enclosure or none of electrode 14 is part of the enclosure. This statement of the electrodes 14 and 16 being "integrally molded" into the housing simply does not support this second mapping offered by Mr. Oslan and Masimo that the metal-plating layer 14b is somehow part of the enclosure while the base metal layer 14a is not. Mills describes that the entire electrode 14 is integrally molded into the housing and therefore it is either all part of the enclosure, or no part of the electrode 14 is part of the enclosure.

116. To be clear, Mills contains no discussion indicating that the outer plating 14b is integrally molded in the housing 12 with the expanse 14a being a separate component, and indeed, Mills discloses the exact opposite. EX1006, 4:32-39. The actual disclosures of Mills simply do not support Masimo's second mapping because either the entire electrode 14 is part of the enclosure, or the entire electrode 14 is not part of the enclosure.

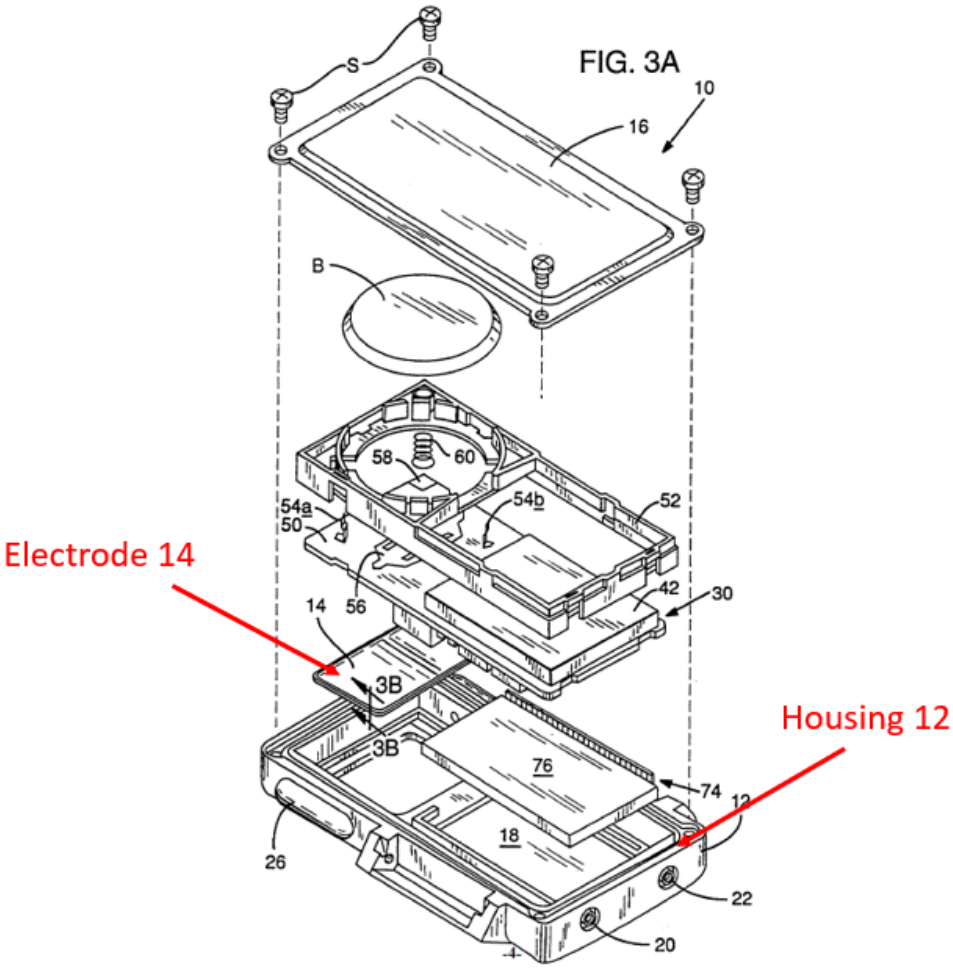
3. *Masimo's Third Mapping of Mills to Claim 1 Fails to Provide All Requirements for the Claimed "first pad"*

117. Much like its second mapping, Masimo's third mapping once again fails to disclose all of the requirements for the first pad recite by claim 1 for multiple reasons. As I previously discussed, with respect to his third mapping of Mills to claim 1, Mr. Oslan alleges that "[t]he top of the trapezoid-shaped leaf spring 62 is a pad." EX1003, ¶60. In presenting this third mapping, he also

provided an annotated version of Figure 2 in which he identified the electrode 14 as an "Upper (First) Portion." *Id.* The Petition identifies the same mapping, referring to the "electrode 14 (first portion)." Pet., 23-24. Mr. Oslan's declaration includes a view of Figure 2 of Mills with the top portion of the leaf spring 62 annotated:

EX1003, ¶60.

118. This third mapping presented by Mr. Oslan and Masimo fails to disclose all elements of claim 1, including all requirements for the claimed "first pad," for multiple reasons. First, the Petition fails to demonstrate that electrode 14 is part of the housing 12. As shown in Figure 3A, the housing 12 and electrode 14 are separate components:

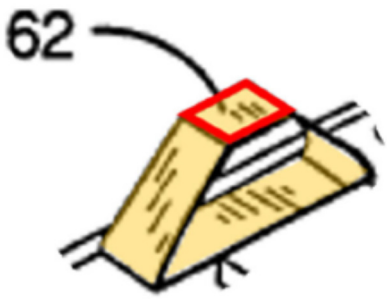


EX1006, FIG. 3A (annotated)

119. As I previously discussed, when mapping Mills to element 1[a] ("an enclosure"), Mr. Oslan identifies the housing 12 of Mills, and only the housing 12, as providing the claimed enclosure. EX1003, ¶57. However, as shown in Figure 3A above, electrode 14 is not part of the housing 12 but rather a separate component. Mr. Oslan avoids confronting this discrepancy by referring to the electrode 14 as only the "Upper (First) Portion" in this third mapping rather than using the full claim language which recites "a first portion ***of the enclosure***."

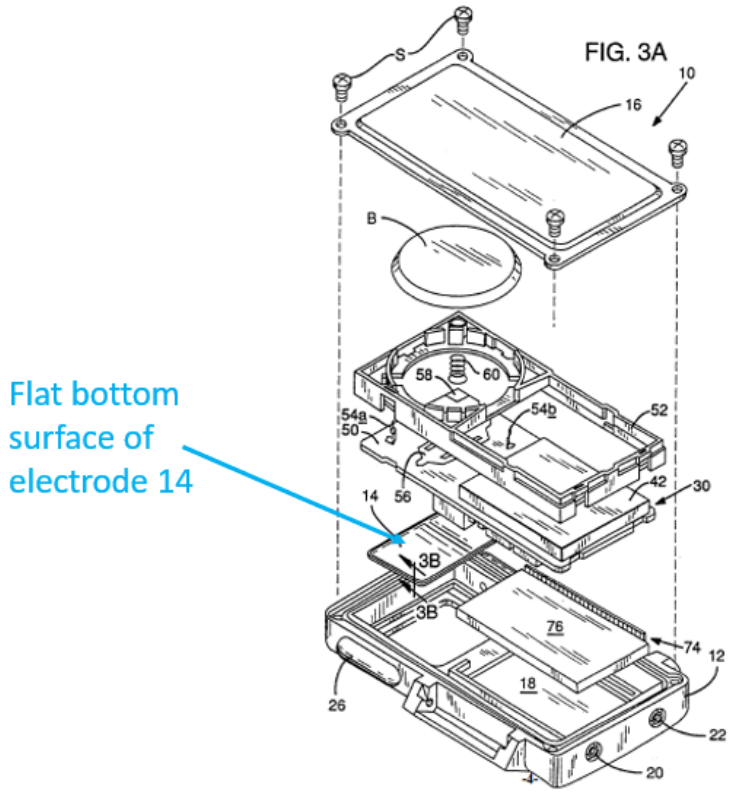
EX1003, ¶60. However, the claims do not merely require that the first pad be embedded in a first portion of the device, it requires that the first pad "is embedded in a first portion ***of the enclosure***." In presenting his third mapping, Mr. Oslan does not identify what disclosures of Mills support an assertion that the electrode 14 reads on the claimed "first portion of the enclosure." EX1003, ¶60. These vague assertions without a detailed discussion of this third, alternative, mapping are not sufficient for Mr. Oslan to demonstrate that this third mapping provides all elements of the claims.

120. As a second reason that this mapping fails to provide all elements of claim 1 (including all requirements for the first pad). Even if it is assumed, without the proper analysis, that the electrode 14 part of the housing of Mills' device, there is simply no disclosure of the top portion of the leaf spring 62 being "embedded in" the electrode 14. Figure 2 shows that the top of portion of the leaf spring 62 is flat:



EX1003, ¶60.

121. The bottom surface of the electrode 14 is also flat:



EX1006, FIG. 3A (annotated)

122. Mr. Oslan agreed that the "electrode inner surface" of electrode 14 in Figure 3A "appears flat." APPLE-2008, 103:10-16. Therefore, when in contact with the electrode 14, the top surface of the leaf spring 62 is merely a flat surface positioned behind and parallel/adjacent to the flat bottom surface of the electrode 14 so as to contact the electrode 14. Mr. Oslan confirms this arrangement of the leaf spring 62 and the electrode 14, stating that the top of the leaf spring "is pressed against the inner wall of electrode 14." EX1003, ¶60 (page 31). This arrangement

of two parallel, flat surfaces in contact with each other simply does not satisfy the requirement that the first pad be "embedded in" the first portion of the enclosure.

123. As I discussed above, the proper construction for the term "embedded in" is "at least partially set in or partially surrounded by a material." Under this proper plain and ordinary meaning of the term, it is not sufficient for the first pad to be simply "pressed against" and parallel to the first portion of the enclosure, the claims require that the first pad be "***embedded in***" the first portion of the enclosure by being at least partially set in or partially surrounded by the first portion of the enclosure.

124. Under the description of the relationship between the top of the leaf spring 62 and the electrode 14 provided by both Mr. Oslan and Masimo that the top of the leaf spring "is pressed against the inner wall of electrode 14 in Mills," this third mapping of Mills to claim 1 fails to disclose all requirements for the first pad recited by claim 1 because the top of the leaf spring 62 being merely "pressed against" the electrode 14 such that the top of the leaf spring 62 is positioned adjacent to and in parallel contact with the electrode 14 does not constitute the leaf spring 62 being "embedded in" the electrode 14 by being partially surrounded by the electrode 14. Similarly, the top of the leaf spring 62 is not "set firmly into and surrounded by" the electrode 14, as Masimo's district court construction would require. A POSTIA would have further recognized that the leaf spring 62 is not

"embedded in" the electrode 14 based on Mills' disclosure that the leaf spring 62 is "slidably yielding." EX1006, 4:67-5:3. Based on this description, a POSITA would have recognized that the top of the leaf spring would not have been "embedded in" the electrode 14 to allow for relative, sliding motion between the two components.

125. Further, as I discussed above in addressing the proper construction for "embedded in," Mr. Oslan's deposition testimony includes his admitted understanding of the meaning of the term "embedded", which he explains excludes situations where a first structure with flat surface being positioned below a second structure with a flat surface, as the second structure is not "an integral part of" the first structure.

126. I note that in the Petition, Masimo does not even allege that the top of leaf spring 62 is embedded in the electrode 14 but rather, more vaguely alleges that "[t]he pad" is "embedded in ***the device*** of Mills." Pet., 23. However, it is not sufficient that the top of the leaf spring 62 be merely embedded in "***the device*** of Mills," the claims require that the top of the leaf spring 62 be embedded in the first portion of the enclosure, which Masimo and Mr. Oslan identify as the electrode 14 in this third mapping. Pet., 24-25.

127. I notice that Masimo and Mr. Oslan refer to this element on the top of the leaf spring as "a pad" and conspicuously avoid referring to this element as a

"first pad" as required by the '257 patent. Mr. Oslan writes: "In addition to the above described ways in which Mills meets the limitation of this Claim 1, Mills further discloses electrode 14 is physically connected to processing circuitry by a leaf spring 62 as shown in Fig. 2." EX1003, ¶60. Mr. Oslan appears to assert that the "pad" of Mills meets the requirements for the first claim without ever saying that this is the "first pad" required by the '257. Mr. Oslan goes on to describe his understanding that this pad is embedded in the electrode because it is pressed against the interior surface of the electrode 14, which is inconsistent with his deposition testimony that a first structure with flat surface being positioned below a second structure with a flat surface, is not embedded in the second structure, as the second structure is not "an integral part of" the first structure.

128. For at least these reasons, Masimo's third mapping of Mills to claim 1 fails. As demonstrated in this and the proceeding sections, none of Masimo's three mappings of Mills to claim 1 demonstrates that the device of Mills includes a "first pad" that is both "embedded in a first portion of the enclosure" and positioned underneath the exterior surface of the first portion" as required by the claims. Both Dr. Oslan and the Petition therefore fail to identify that any of the three mappings provide all elements of claim 1.

4. Masimo's Third Mapping of Mills to Claim 1 Fails to Provide the Claimed "first connector" of Claim 1

129. In addition to the above described deficiencies, both Mr. Oslan and the Petition fail to identify how the third mapping provides the claimed "first connector coupled to the first pad and provides the first electrical signal detected by the first pad to the processor" recited by claim 1. As I mentioned above, when switching between the various mappings, Mr. Oslan fails to complete the analysis of any single mapping with respect to all of the claim elements. This is particularly apparent in his analysis of what he identifies as Limitation 1[c], which includes the above reproduced recitation regarding the claimed "first connector."

130. That is, after introducing the above described third mapping (in which Mr. Oslan maps the top of the leaf spring 62 to "a pad" and the electrode 14 to the "first portion" of the enclosure), neither Mr. Oslan nor the Petition addresses how discloses the claimed "first connector ***coupled to the first pad***." In his analysis of Limitation 1[c], Mr. Oslan reverts back to the first mapping, stating that "Electrodes 14 and 16 are thin mats that are part of the electrical path of a lead and are therefore pads." EX1003, ¶65. Earlier in this same paragraph, Mr. Oslan states that "Electrodes 14 and 16 are electrically connected to the PCB 50 via a respective spring (60/62)." *Id.* Mr. Oslan does not identify any other components of Mills device as allegedly providing the claimed "first connector" other than the leaf spring 62. *Id*. During his deposition, Mr. Oslan confirmed that in analyzing

Element 1[c] he only identified that "the leaf spring 62 is the connector for the electrode 14" and that he had not identified any other connectors. APPLE-2008, 73:12-75:13. Masimo's third mapping of Mills to claim 1 therefore fails to the claimed "first connector" which is coupled to the first pad" because the same portion of leaf spring 62 cannot provide both the claimed first pad and the claimed first connector as these are two separate claim recitations. In analyzing Limitation 1[c], Mr. Oslan only addresses the first mapping (or at most the first and second mappings) in which the electrode provides the claimed first pad. Mr. Oslan therefore fails to demonstrate that the first pad in its third mapping is "coupled to" an electrical connector "configured to provide the first electrical signal detected by the first pad to the processor" in the device.

131. Earlier, in paragraphs 71-74, I summarized the mappings, highlighting that the mapping chosen for elements 1[a] and 1[b(i)] specifically identify the housing 12 as the "enclosure" and the entire electrode 14 as a "first pad". Once these specific single selections have been made for these first two claim elements, and the housing 12 and electrode 14 have been selected for these elements, these elements cannot be re-purposed or recycled to represent other elements of the claims. In the analysis of the later elements provided by Mr. Oslan, in which portions of the housing 12 and the electrode 14 are carved out of these elements and then used interchangeably to cover one required element of the claims and then

another and another, all of this is inconsistent with the identifications made for elements 1[a] and 1[b(i0].

132. Throughout all of this, there is no clear connection between each of the individual assertions about the mapping of elements to claim terms that would comprise a complete mapping of a single set of elements to the elements of the entire claim. In the discussion above, I've presented the mappings for just 4 of the claim terms, and even in this limited set, there is no consistent combination throughout just these 4 terms that can meet these limitations. Specifically, if the housing 12 is an "enclosure" and the electrode 14 is a "first pad", most of the choices for the third and fourth claim terms are not available as they have already been mapped to one of these first two elements. Of those that remain, there are none that can simultaneously meet the first 3 claim terms or all 4 of these claim terms.

C. The Petition Fails to Demonstrate that Mills Provides Additional Elements of the Dependent Claims

133. In addition to the above described deficiencies of each of the three mappings of Mills to claim 1 discussed above, Masimo and Mr. Oslan fail to demonstrate that Mills discloses all elements of several of the dependent claims that depend from claim 1. I address these claims below and the deficiencies in the Petition and the analysis of Mr. Oslan below.

1. The proposed mappings of Mills to the '257 Patent fail to provide all elements of claim 3

134. In addition to the above deficiencies, including that Masimo fails to demonstrate that all the elements of Claim 1 are met by Mills, and therefore Claim 3 which depends from Claim 1 is also invalid, both Mr. Oslan and the Petition also fail to demonstrate that Mills provides the additional disclosures of Claim 3. In his analysis of claim 3, Mr. Oslan states that "Mills discloses its housing 12 may be molded plastic, such as acrylonitrile-butadiene-styrene (ABS)" and that "[p]lastics, in general, are well-known electrical insulators and ABS plastic is an electrical insulator." EX1003, ¶68. Mr. Oslan also states that the housing 12 of Mills is made from a molded plastic that is an electrical insulator and that the housing 12 "separates its ***two electrodes*** 14, 15.[2]" EX1003, ¶68. However, claim 3 does not recite that the first and second pads are electrically isolated but rather specifies that "the ***first portion*** is electrically isolated from the ***second portion***." EX1001, 12:53-54. These recitations draw their antecedent basis from claim 1 and therefore are referring to the "first portion of the enclosure" and the "second portion of the enclosure" recited in claim 1. *Id.*, 12:26-27, 12:36.

[2] The numeral "15" here appears to be a typographical error. I assume that Mr. Oslan was refering to electrodes 14 and 16 of Mills in this paragraph.

135. Furthermore, earlier, when addressing claim 1, Mr. Oslan expressly states that "Electrode 16 in Fig. 3A of Mills ***is a second pad***." EX1003, ¶61. That is, Mr. Oslan identifies the Electrode 16 as the claimed second pad, not the second portion of the enclosure. Mr. Oslan's assertions with respect to claim 3 are therefore irrelevant to the actual claim language because claim 3 requires that that the first portion of the enclosure is electrically isolated from the second portion of the enclosure, not electrically isolated from the second pad (electrode 16 in Mills under Mr. Oslan's mapping).

136. Mr. Oslan fails to demonstrate that Mills meets claim 3 because in his declaration he has not identified which portion of Mills' housing 12 he considers to be the claimed "second portion of the enclosure." EX1003, ¶¶61-62. For example, Mr. Oslan asserts that "Electrode 16 of Mills is embedded in housing 12" but does not identify which portion of the housing 12 he considers to be the claimed "second portion of the enclosure" distinct from the "first portion of the enclosure." *Id.*, ¶62. Mr. Oslan's analysis of claim 3 therefore fails to demonstrate that the second portion of the enclosure (which is never expressly identified in Mr. Oslan's declaration or the petition) is electrically isolated from the first portion of the enclosure. *Id.*, ¶68.

137. As I previously discussed, Masimo and Mr. Oslan provide a first mapping of Mills to the claims in which the housing 12 as the claimed "first

portion of the enclosure," asserting that "electrode 14 (first pad) is 'integrally molded' (*i.e.*, embedded) into the housing." Pet., 19. However, nowhere in the analysis of claim 1 in either the Petition or Mr. Oslan's declaration addressing the first mapping do they identify which parts of housing 12 provide the claims first and second portions and therefore the Petition fails to identify that the first and second portions of the housing 12 are electrically isolated.

138. Turning to the second and third mappings provided by Mr. Oslan and Masimo, Mr. Oslan asserts that either the outer coating 14b of electrode 14 or all of electrode 14 provides the claimed first portion of the enclosure. *See e.g.*, Pet., 22-25. However, once again, Masimo fails to identify which portion of housing 12 it considers to be the "second portion" in these two mappings. Therefore, the analysis of claim 3 in both Mr. Oslan's declaration and in the Petition fail to demonstrate that the first portion is electrically isolated from the second portion, as required by claim 3. For these reasons, the Petition fails to demonstrate that Mills provides claim 3.

2. The proposed mappings of Mills to the '257 Patent fail to provide all elements of claim 4.

139. In addition to the above deficiencies, including that Masimo fails to demonstrate that all the elements of Claim 1 are met by Mills, and therefore Claim 4 which depends on Claim 1 is also invalid, both the Petition and Mr. Oslan fail to

demonstrate that Mills provides the additional disclosures of Claim 4. Mr. Oslan's analysis of claim 4 is itself faulty for the same reasons that I discussed above with respect to claim 3. As I discussed above, when addressing claim 1, Mr. Oslan expressly states that "Electrode 16 in Fig. 3A of Mills ***is a second pad***." EX1003, ¶61. However, Mr. Oslan fails to demonstrate that Mills meets claim 4 because in his declaration he has not identified which portion of Mills' housing 12 he considers to be the claimed "second portion of the enclosure." EX1003, ¶¶61-62. For example, Mr. Oslan asserts that "Electrode 16 of Mills is embedded in housing 12" but does not identify which portion of the housing 12 he considers to be the claimed "second portion of the enclosure" distinct from the "first portion of the enclosure." *Id.*, ¶62. Mr. Oslan's analysis of claim 3 therefore fails to demonstrate that the second portion of the enclosure (which is never expressly identified in Mr. Oslan's declaration or the petition) is electrically isolated from the first portion of the enclosure by a third portion of the enclosure having a conductivity insufficient to transmit the first electrical signal from the first pad to the second pad via the third portion. *Id.*, ¶¶69-70.

3. The proposed mappings of Mills to the '257 Patent fail to provide all elements of claim 10.

140. In addition to the above deficiencies, including that Masimo fails to demonstrate that all the elements of Claim 1 are met by Mills, and therefore Claim

10 which depends from Claim 1 is also invalid, the Mr. Oslan and the petition fail to demonstrate that Mills provides the additional disclosures of Claim 10. Specifically, when addressing claim 10, Mr. Oslan states that "electrode 16 (second lead)…***is part of the second portion of the enclosure***." EX1003, ¶74. However, this brief paragraph provides no analysis or reasoning as to what makes electrode 16 part of housing 12 and therefore part of the enclosure. *Id.*

141. Furthermore, as I discussed above with respect to claims 3 and 4, when addressing claim 1, Mr. Oslan expressly states that "Electrode 16 in Fig. 3A of Mills ***is a second pad***." EX1003, ¶61. The electrode 16 cannot provide both the claimed "second pad" and the claimed "second portion of the enclosure" because claim 1 requires that the "second pad…***is embedded in*** a second portion of the enclosure." Logic dictates that a component cannot be embedded in itself. It would have been readily apparent to a POSITA that claim 1 (from which claim 1 depends) recites the "second pad" and the "second portion of the enclosure" as distinct structural elements, with the second pad being embedded in the second portion of the enclosure. Mills' electrode 16 therefore cannot be read on both the second pad and the second portion of the enclosure of claim 1. The Petition therefore fails to explain how "the second lead is configured to detect the second electrical signal of the user's cardiac signal via the user's contact ***with the second portion of the enclosure***" as recited by Claim 10.

142. Furthermore, as I identified above, Mr. Oslan asserts that "Electrode 16 of Mills is embedded in housing 12" and therefore equates the "housing 12" of Mills to the claimed "second portion of the enclosure" (without expressly identifying which portion of the housing 12 he considers to be the claimed "second portion of the enclosure" distinct from the "first portion of the enclosure"). *Id.*, ¶62. Mr. Oslan also states that "Mills discloses its housing 12 may be molded plastic, such as acrylonitrile-butadiene-styrene (ABS)" and that "[p]lastics, in general, are well-known electrical insulators and ABS plastic is an electrical insulator." EX1003, ¶68. Mr. Oslan's analysis of claim 10 therefore fails to identify how Mills discloses the recited claim elemnts because the second portion of the enclosure identified by Masimo (all or a portion of housing 12) is an electrical insulator and therefore cannot provide electrical connectivity from the user's contact to the second lead.

II. Ground 2 Fails to Demonstrate That All Elements of Claims 1-4 and 8-22 are Provided by Markel in View of Mills

A. The Combination of Markel with Mills Fails to Provide All Elements of Claim 1

143. In Ground 2, both Mr. Oslan and the Petition continue to be deficient for its lack of clarity or identification of how the cited references teach all of the limitations of the challenged claims continues. Similar to the analysis found in Claim 1 in Ground 1, the arguments found in Ground 2 of the Petition also present

multiple mappings of the combination of Markel and Mills to Claim 1 and abruptly shifts from its first mapping to a second mapping midway through its analysis of Claim 1 without any indication that it has shifted its mapping or that it has presented alternative theories of the case.

144. Turning to the analysis of Ground 2 in the Oslan Declaration, in his first mapping of Markel and Mills to Claim 1, Mr. Oslan mapped the main body portion 110 in Markel to the claimed enclosure. EX1003, ¶79. For example, Mr. Oslan discusses the "main body portion 110" and then concludes that "[a] POSITA would understand from this disclosure that Markel discloses an enclosure." *Id.* In the section discussing claim element 1[a], the only item from Markel+Mills that is identified as meeting the requirements of an "enclosure" is the "main body portion 110." This first mapping in which Mr. Oslan equates the main body portion 110 to the claimed enclosure is mirrored in the Petition.

145. In the section discussing elements 1[b(i)]-1[b(iv)], Mr. Oslan's paragraphs 81-83 make statements that associate the region 410b with the required first pad of the claim. Unfortunately, the annotated figure provided by Mr. Oslan identifies the region 410b as a "First Portion/Electrode(Pad)", which blends two distinct and required claim elements, and opens the door to the subsequent language of the declaration which blends the mapping of the region 410b or portions of the region 410b to the enclosure, the first portion of the enclosure

and/or the first pad with the same kind of re-use and recycling of prior art elements that was provided in the first ground.

146. The Petition follows this confusing approach, alleging that electrode located on a region 410b of the exterior of Markel's device maps to the claimed "first pad." The Petition states that from this disclosure of Markel stating "[a] first electrode 'placed on or molded into the region 410b,'" "[a] POSITA would understand that Markel describes a first pad formed of conductive plastic embedded in a first portion of the enclosure." Pet., 42. This statement is followed with the annotated version of Markel's Figure 4 in which it labels the region 410b as both the "1st Portion" and the "Electrode (Pad)." *Id.*, 43.

147. This mapping in the declaration and in the petition fails as the claims require that the "first pad is embedded in a first portion of the enclosure." The electrode located at region 410b cannot simultaneously provide two required claim elements from the '257 - the "first portion" of the enclosure and the "first pad". Further, as these two required claim elements have a required relationship in the claims "…a first pad that is embedded in a first portion of the enclosure", and "the first pad is positioned underneath an exterior surface of the first enclosure", it is impossible for the region 410b to satisfy these terms. As I discussed above with respect to Ground 1, logic dictates that a component/material cannot be embedded

in itself. The annotated version of Markel's Figure 4 provided in the Petition (and in paragraph 82 of the Oslan Declaration) is therefore somewhat confusing.

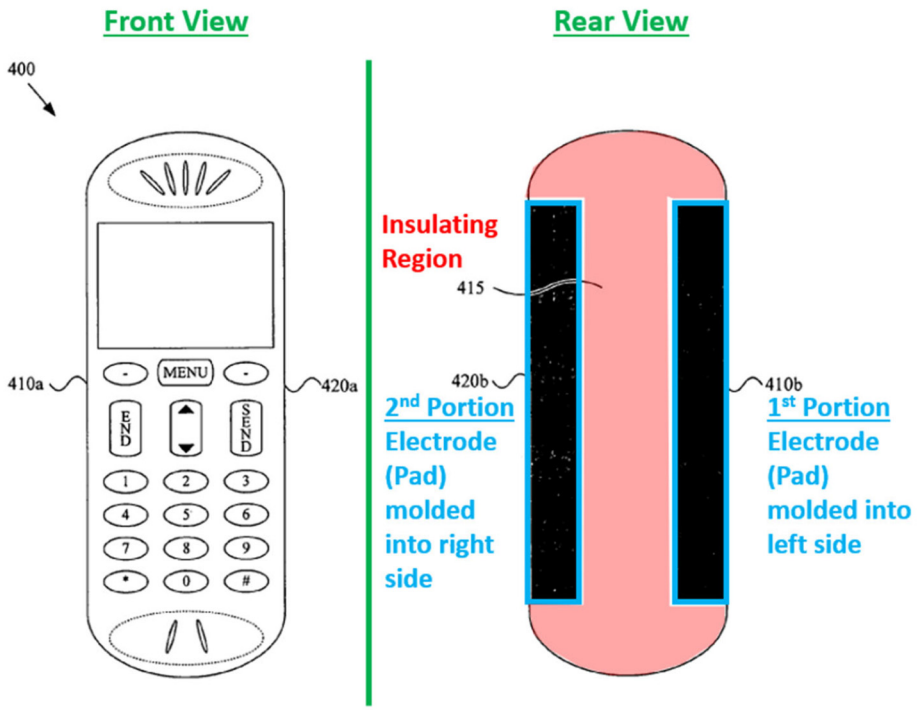


Figure 4

Annotated FIG. 4 of Markel as presented at Pet., 43.

148. After providing this initial mapping, Mr. Oslan switches to a second mapping. Specifically, Mr. Oslan asserts that in the proposed combination of Markel with Mills, a POSITA would have applied the teachings of Mills to Markel such that "[t]he top of the trapezoid-shaped leaf spring 62 is ***a*** pad." EX1003, ¶84 (page 50). As was the case in his analysis of Ground 1 based on Mills alone, Mr. Oslan once again does not ever expressly state that the top of the leaf-spring 62 is the claimed "first pad" but rather merely asserts that it is "a pad." *Id.*

149. There is some language in paragraph 84 of Mr. Oslan's declaration that identifies the electrode 14 of Mills as a first pad, and the leaf spring of Mills as a "pad" that functions as a connector. Specifically, in paragraph 84, "Mills further discloses electrode 14 is physically and electrically connected to processing circuitry (ECG amplifier 32) by a leaf spring 62 as shown in Fig. 2." As was the case throughout Ground 1, the declaration refers to this portion of the leaf spring as "a pad" (not the required "first pad"), and goes on to explain that "leaf spring 62 is a pad embedded in the enclosure of device 100, the pad is underneath the exterior surface, and the pad is configured to detect an ECG signal of the user via its contact with electrode 14 located on the exterior surface " Mr. Oslan's description of the flat portion of the leaf spring as embedded in the enclosure is inconsistent with his own stated understanding of "embedded" and specifically that a first object with a flat surface in contact with the flat surface of a second object is not embedded in that second object, as discussed with respect to the first ground. In any case, it is unclear if Mr. Oslan is intending to associate this portion of the leaf spring 62 with the claimed first pad, or with the connector, as there is never a clear statement that this element is a "first pad". This vagueness about the role of the leaf spring mirrors the discussion in the first ground, and is also highlighted in the deposition testimony, wherein Mr. Oslan stated that "I'd have to go back and do an analysis of that, and I can't answer that at this time."

150. Mr. Oslan continues with this mapping throughout Ground 2 by equating the electrode located at region 410b with the first portion of the enclosure. For example, Mr. Oslan states that "Markel discloses in annotated Fig. 4 below region 410b (first portion) and region 420b (second portion)." EX1003, ¶94. In another example, Mr. Oslan states "Markel discloses region 410b (first portion) and the region 420b (second portion) may include conductive plastic." *Id.*, ¶96. The Petition mirrors this mapping provided by Mr. Oslan. For example, the Petition states that "the ***pad region 410b is a first portion of the exterior surface*** of the enclosure of the device 400." Pet., 48-49 (discussing "the ***electrodes/first portion 410b*** exterior surface of Markel.").

151. As I discuss in greater detail below, neither of these mappings of Markel and Mills provide all of the limitations recited in claim 1.

1. Markel's Electrode 410b Cannot be the "first pad" of Claim 1

152. The Petition identifies the electrode 410b as "a first pad" in the first mapping of the combination of Markel and Mills to Claim 1. Pet., 42-43. But electrode 410b cannot be the "first pad" of Claim 1 because electrode 410b is not "positioned underneath the exterior surface of the first portion" of the enclosure as

required by Element 1[b(iii)].[3] Instead, electrode 410b is positioned on the outer surface of Markel's housing. In fact, by the time the Petition discusses Element 1[b(iii)], Masimo appears to have disregarded its first mapping of the combination of Markel and Mills because all Masimo states in addressing this element under Ground 2 is that:

> The combined device of Markel and Mills as discussed above would include ***the pad of leaf spring 62 positioned underneath the electrodes/first portion 410b exterior surface of Markel***. Accordingly, this limitation would have been obvious in view of Markel and Mills.

Pet., 49.

153. The reason why the Petition abandons its first mapping part way through the analysis of claim 1 is likely because Markel is clear in its disclosure that the "first and second electrodes [are] ***disposed on*** a main body portion 110," instead of being positioned ***underneath*** the body portion 110 (alleged ***enclosure***). EX1005, [0045] (describing Figure 4). Markel continues that "[a] first electrode may, for example, be placed on the left side portion 410 (e.g., placed on or molded into region 410b), and a second electrode may, for example, be placed on the right

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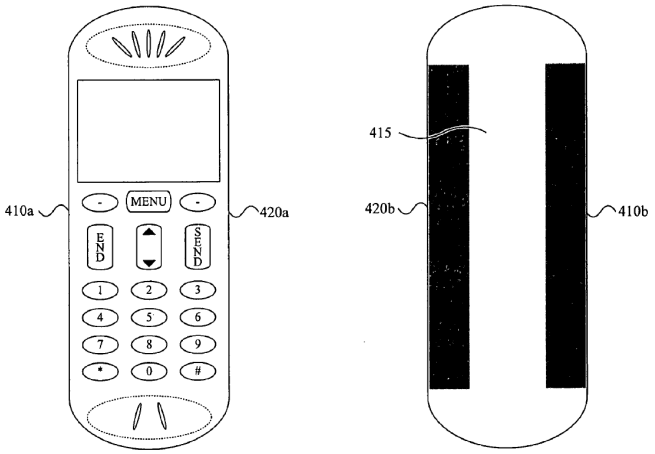
[3] Masimo changes its claim element numbering between Grounds 1 and 2. Patent Owner adopts the different element numbering schemes for the different Grounds so that the numbering aligns between the Petition and this brief.

side portion 420 (e.g., placed on or molded into region 420b)." *Id*. There is no teaching or suggestion in the disclosure of Markel to embed the electrodes 410b and 420b *underneath* an exterior portion of the device.



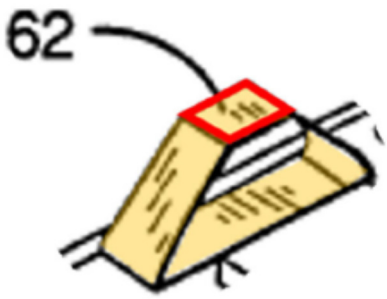
EX1005, FIG. 4.

154. In a further example, Markel teaches placing the electrodes "*on* side or rear portions of the main body portion 100" to "provide **for *electrode contact with a user's hand*** during use of the MCD 100." EX1005, [0043]. A POSITA would have understood from Markel's teaching that an electrode placed underneath the exterior portion of the housing would not "provide for electrode contact with a user's hand" as Markel describes.

155. For at least these reasons, Masimo's first mapping of Markel and Mills fails to disclose all of the limitations of claim 1.

2. *Masimo's Second Mapping of Markel with Mills to Claim 1 Fails to Provide All Elements of Claim 1, Including the Claimed "first pad"*

156. As I discussed above, in the second mapping of the combination off Markel and Mills to claim 1, both Mr. Oslan and the Petition map "[t]he top of the trapezoid-shaped leaf spring 62" of Mills to "a pad" and the electrode 410b of Markel to the claimed first portion of the enclosure. EX1003, ¶¶84-87, 94, 96, Pet., 46, 48-49. Mr. Oslan's declaration includes a view of Figure 2 of Mills with the top portion of the leaf spring 62 annotated:



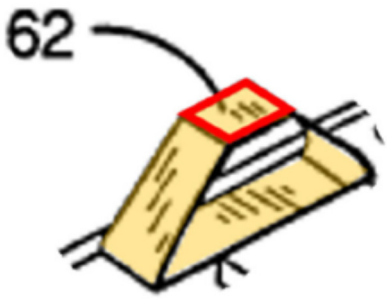
EX1003, ¶84.

157. In describing the proposed combination of Markel and Mills, Mr. Oslan states that the "top pad portion" of the leaf spring 62 of Mills "is placed underneath an exterior surface material and ***against an inner wall*** of the exterior surface material." EX1003, ¶87. But it is not sufficient that the top of Mills leaf spring 62 be merely "placed…against" the first portion of the enclosure. Instead, Claim 1 requires that the "first pad…***is embedded in*** a first portion of the enclosure."

158. As I discussed in the claim construction section, above, the proper meaning of the term "embedded in" is "at least partially set in or partially surrounded by a material." As I discussed previously in the claim construction section, the specification of the '257 patent draws a clear distinction between leads that are "embedded in" a housing and leads that are embedded "adjacent to the housing." EX1001, 10:24-29, 9:44-48 (differentiating between a lead that is "positioned against" an inside surface of the housing and a lead that is embedded "within the thickness of" the housing.).

159. Therefore, even under the framing of the relationship of Mills' leaf spring 62 to Markel's electrode 410b in the proposed combination provided by both Mr. Oslan and Masimo, this second mapping of the proposed combination of Markel and Mills to claim 1 does not disclose all requirements of claim 1 because it fails to provide a first pad that is both embedded in a first portion of the enclosure ***and*** positioned underneath the exterior surface of the first portion of the enclosure. As I previously discussed in Ground 1, above, in Mills does not include any description of the top portion of the leaf spring 62 being "embedded in" any of the electrodes of Mills device. Therefore, in applying Mills to Markel to include the leaf spring 62 in the device of Markel, a POSITA similarly would not have embedded the top portion of the leaf spring 62 in the electrode at region 410b of Markel's device because neither reference includes any teaching to do so.

160. As I previously discussed, Figure 2 shows that the top of portion of the leaf spring 62 is flat:



EX1003, ¶84.

161. Furthermore, there are no details in Markel for the specific geometry for the portion of electrode 410b that faces an interior of Markel's device. Mr. Oslan confirmed this lack of disclosure in Markel, stating that "Markel does not get into the details of how…the inside of the electrodes" are configured. APPLE-2008, 86:15-21, 112:10-13. Furthermore neither Mr. Oslan or the Petition propose any modification or implementation for the inner face of the electrode located at region 410b that would be allegedly obvious to a POSITA. Masimo merely alleges that the electrode 410b would have "an inner wall." Pet., 48. The inner configuration for the electrode 410 at region 410b is therefore unknown. The only guidance for the inner configuration of an electrode in the combination is the electrode 14 of Mills. As I previously discussed, the inner surface of the electrode 14 in Mills is flat. EX1006, FIG. 3A; APPLE-2008, 103:10-16.

162. The configuration described in the Petition and by Mr. Oslan of including the leaf spring of 62 in Markel's device such that the flat upper portion of the leaf spring 62 is "placed…against" and parallel to an inner surface of electrode 410b (Pet., 48) simply does not satisfy the requirements of claim 1. This is because two flat surfaces being placed in parallel contact with each other does not constitute the leaf spring 62 being "embedded in" the electrode 410b. Furthermore, as I discussed in my analysis of Ground 1, above, there is no disclosure in Mills of the leaf spring 62 being "embedded in" an electrode or any other component. There is simply no disclosure or suggestion in either Markel or Mills of a pad being "embedded in" the electrode 410b.

163. As I discussed above, the proper construction for the term "embedded in" is "at least partially set in or partially surrounded by a material." Under this proper plain and ordinary meaning of the term, it is not sufficient for the first pad to be simply "placed…against" and parallel to the first portion of the enclosure, the claims require that the first pad be "***embedded in***" the first portion of the enclosure by being at least partially set in or partially surrounded by the first portion of the enclosure.

164. Similarly, the top of the leaf spring 62 is not "set firmly into and surrounded by" the electrode located at region 410b in the proposed combination of Markel with Mills, as Masimo's district court construction would require. A

POSTIA would have further recognized that the leaf spring 62 is not "embedded in" the electrode located at region 410b in the proposed combination of Markel with Mills based on Mills' disclosure that the leaf spring 62 is "slidably yielding." EX1006, 4:67-5:3. Based on this description, a POSITA would have recognized that the top of the leaf spring would not have been "embedded in" the electrode 14 to allow for relative, sliding motion between the two components.

165. Summarizing the above, the portion of the leaf spring because it is not embedded in the first portion of the enclosure (the electrode located at region 410b) and also because of the consistently vague discussion of this element as a "pad", but not a first pad, and Mr. Oslan's deposition testimony when asked if this element was a "first pad" that "I'd have to go back and do an analysis of that, and I can't answer that at this time." APPLE-2008, 48:22-49:6.

166. For at least these reasons, Masimo's second mapping of the combination of Markel and Mills to claim 1 also fails to provide claim 1. Ground 2 therefore fails with respect to claim 1 and its dependent claims.

3. *Masimo's Second Mapping of the Combination of Markel with Mills to Claim 1 Fails to Provide Claimed "First Connector"*

167. In addition to the above described deficiencies, both Mr. Oslan and the Petition fail to identify how the second mapping of the combination of Markel with Mills provides the claimed "first connector coupled to the first pad and

provides the first electrical signal detected by the first pad to the processor" recited by claim 1 (Limitation 1[c]). Specifically, in addressing Limitation 1[c], both the Petition and Mr. Oslan shift back to the first mapping and do not even present a theory as to how the proposed second mapping of the combination of Markel and Mills would provide the claimed "first connector."

168. For example, in addressing Limitation 1[c], Mr. Oslan describes the embodiment shown in Figure 20 of Markel in asserting that Markel discloses a first connector. In addressing Figure 20, Mr. Oslan states:

> Markel discloses a first and second lead configured as a first pad 2024 and second pad 2022, respectively, on a portion of the exterior housing, and the first and second pads each connected to a processor, as shown in annotated Figs. 4 and 20 below. EX1005, Figs. 4, 20. A POSITA would understand from this disclosure that Markel teaches a first lead with a first connector coupled to a first pad that provides a first electrical signal from the first pad to the processor, and a second lead with a second connector coupled to a second pad that provides a second electrical signal from the second pad to the processor.

EX1003, ¶91.

169. Looking at this analysis from Mr. Oslan, it is clear that he relies on the disclosures of Figures 4 and 20 of Markel alone as disclosing the claimed "first connector coupled to the first pad and provides the first electrical signal detected by the first pad to the processor." However, these disclosures of Markel simply

provide a schematic which indicates that there are some electrical connections between the electrodes positioned on the exterior of Markel's device to the processing circuitry therein. There is no discussion by Mr. Oslan of how the second mapping, in which the leaf spring 62 of Mills provides the claimed "first Pad," would provide this claim limitation.

170. The Petition includes a highly similar analysis to that found in Mr. Oslan's declaration with respect to this claim limitation. For example, after discussing the "cardiovascular monitoring capability" of Markel's device at a high level (Pet., 51-52), the Petition states:

> Markel discloses a ***first and second lead*** configured as a ***first and second pad***, respectively, on ***a portion of the exterior housing***, and the first and second pads each connected to a processor, as shown in annotated Figs. 4 and 20 below.

Pet., 52.

171. The Petition then includes an annotated version of Figure 20 of Markel with the external electrodes clearly identified as corresponding to the claimed first and second pads while with connecting wires connecting the electrodes 2022 and 2024 to the Cardiac Info Acquisition Module 2010:

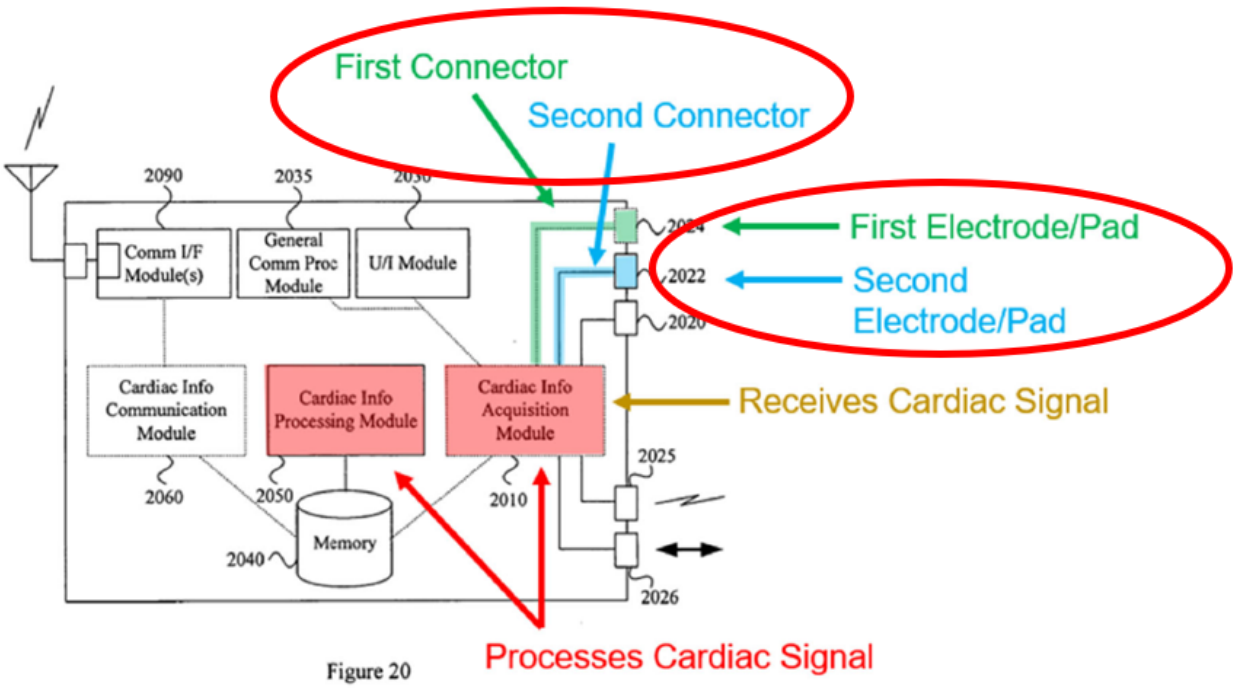


Figure 20

Pet., 53.

172. In other words, in addressing Element 1[c], the Petition switches back to a mapping in which one of the external electrodes of Markel (which are not positioned underneath the exterior surface of a first portion of the enclosure) allegedly reads on the claimed first pad and identifies the lines in the schematic disclosed by Markel as allegedly providing the claimed "first connector." Pet., 51-53. As I discussed with respect to Mr. Oslan's analysis of Limitation 1[c], above, the Petition also does not include any discussion of how the leaf spring 62 of Mills (which allegedly provides the claimed "first pad" in Masimo's second mapping) is connected to the processor via a first connector. In fact, in describing the proposed combination of Mills with Markel, the Petition describes the leaf spring 62 of Mills

as replacing the connectors of Markel. Pet., 47 ("Leaf springs are well known electrical connectors"). Yet in the analysis of Limitation 1[c], the Petition disregards this modification and refers to the connectors of Markel as allegedly providing the claimed first and second connectors. There is simply no explanation in the Petition of how the connectors of Markel would be arranged in the proposed combination to couple the leaf spring 62 to Markel's processor. Pet., 51-53. Indeed, in the analysis of Element 1[c], the Petition provides no discussion of Mills' leaf spring 62.

173. Due to its failure to identify any mechanism by which the leaf spring 62 of Mills connects to processor of Markel (or Mills) via a first connector in its second mapping of the combination of Markel and Mills to claim 1, this additionally demonstrates that the combination of Markel and Mills described in the Ground 2 fails to provide all elements of Claim 1.

B. The Petition Fails to Demonstrate that the Combination of Markel with Mills Provides Additional Elements of the Dependent Claims

174. In addition to the above described deficiencies off the combination of Markel with Mills with respect to claim 1, Masimo and Mr. Oslan fail to demonstrate that the combination of Markel with Mills discloses all elements of several of the dependent claims that depend from claim 1. I address these claims below and the deficiencies in the Petition below.

1. *The proposed mappings of the combination of Markel with Mills to the '257 Patent fail to provide all elements of claim 2*

175. In addition to the above deficiencies, including that Masimo fails to demonstrate that all the elements of Claim 1 are met by Mills+Markel, and therefore Claim 2 which depends from Claim 1 is also invalid, the both Mr. Oslan and the Petition also fail to demonstrate that Mills+Markel provides the additional disclosures of Claim 2.

176. The Petition provides two theories regarding how Markel provides Claim 2. The first theory is based on Figure 4. Pet., 54-56. Masimo's first theory fails because Figure 4 shows both electrodes 410b and 420b positioned along the back side of the device and fails to provide side views showing that either of electrodes 410b and 420b contain any portion positioned on the sides of the device. This view does not show that the electrodes 410b and 420b are positioned on opposite sides of the device.

177. Masimo's second theory based on Figure 5. But this theory also fails because it is based on a completely different embodiment of Markel from the Petition's analysis of Claim 1, which Claim 2 depends from. Pet., 55-56. The Petition does not provide any description of how the embodiment of Figure 5 would be combined with the embodiment of Figure 4 (and with Mills) to provide all of the limitations recited in Claim 1. *Id.* For example, the Petition fails to address how a first pad would be both embedded in and positioned underneath

Markel's electrode 510 (identified by Masimo as "1st Portion"). Pet., 55-56. The electrode 510 of Markel is vastly different from the electrodes 410b and 420b of Figure 4 because "first electrode 510 [is] positioned on a send button." EX1005, [0046]. And yet, the Petition does not explain how this electrode would work with Mills' leaf spring 62. Furthermore, the Petition fails to explain how this configuration would provide all of the elements recited in claim 1.

178. For the reasons provided above, both Masimo's first and second theories of how the combination of Markel and Mills meets claim 2 fails.

2. *The proposed mappings of the combination of Markel with Mills to the '257 Patent fail to provide all elements of claim 9.*

179. In addition to the above deficiencies, including that Masimo fails to demonstrate that all the elements of Claim 1 are met by Mills+Markel, and therefore Claim 9 which depends on Claim 1 is also invalid, the both Mr. Oslan and the Petition also fail to demonstrate that Mills+Markel provides the additional disclosures of Claim 9.

180. In the analysis of Claim 9, the Petition states that the combination of Markel and Mills discloses claim 9 because "Markel discloses that an electrode may be integrated or embedded into the touch screen of display 140." Pet., 58-59. But the Petition fails to demonstrate that the proposed combination discloses or suggests "wherein at least a portion of the exterior surface of the enclosure forms

at least a portion of an exterior surface of the electronic device ***behind*** the display" as recited by Claim 9. In fact, the Petition provide no discussion of this portion of Claim 9. Pet., 58-59.

181. For the reasons provided above, the Petition fails to show obviousness of Claim 9.

3. *The proposed mappings of the combination of Markel with Mills to the '257 Patent fail to provide all elements of claim 10.*

182. In addition to the above deficiencies, including that Masimo fails to demonstrate that all the elements of Claim 1 are met by Mills+Markel, and therefore Claim 10 which depends on Claim 1 is also invalid, the both Mr. Oslan and the Petition also fail to demonstrate that Mills+Markel provides the additional disclosures of Claim 10.

183. In its analysis of Claim 10 (and Claim 1), the Petition identifies electrode 420b of Markel as allegedly providing the claimed "second pad." Pet., 60. The Petition further states that the user may contact the electrodes 410b and 420b. *Id.* However, claim 10 does not require user contact with the second pad and instead recites "the user's contact *with the second portion of the enclosure.*" The electrode 420b is an externally exposed electrode (EX1005, FIG., 4, [0043], [0045]) so it does not detect the second electrical signal due to user contact with a second portion "***of the enclosure.***" Instead, electrode 420b appears to detect the

second electrical signal due to user contact by direct user contact with the electrode 420b itself. The Petition therefore fails to demonstrate that the combination of Markel and Mills provides claim 10.

4. The proposed mappings of the combination of Markel with Mills to the '257 Patent fail to provide all elements of claim 12.

184. In addition to the above deficiencies, including that Masimo fails to demonstrate that all the elements of Claim 1 are met by Mills+Markel, and therefore Claim 12 which depends on Claim 1 is also invalid, the both Mr. Oslan and the Petition also fail to demonstrate that Mills+Markel provides the additional disclosures of Claim 12.

185. Claim 12 recites "wherein ***the first portion*** of the enclosure is a bezel." As previously discussed above, in its first mapping of the combination of Markel and Mills to claim 1, the Petition maps the portion of enclosure surrounding electrode 410b to the claimed "first portion of the enclosure" while in its second read, Masimo maps the electrode 410b to the first portion of the enclosure. Pet., 42-43, 48-49. The Petition completely disregards both of these mappings of Markel and Mills. Instead, the Petition identifies a completely different portion of Markel's device as allegedly corresponding to the claimed first portion of the enclosure. Pet., 62. This slight of hand in the Petition should not be allowed.

186. In particular, the Petition states that Markel teaches embodiments in which "an electrode may be disposed on a border of the display" to address claim 12. Pet., 62. But this assertion is made with respect to Markel's discussion of Figure 15 and the Petition fails to describe how the embodiment of Figure 15 would be combined with the embodiment of Figure 4. Moreover, the Petition fails to explain how the embodiment of Figure 15 meets all of the limitation recited in Claim 1. For instance, the Petition does not demonstrate how the electrodes 1530 or 1531 would be positioned "underneath the exterior surface of the first portion" as required by claim 1 from which claim 12 depends.

187. Additionally, the Petition fails to show how the electrode 410b of Markel (the alleged "first portion of the enclosure" in Masimo's second mapping (Pet., 48-49)) "is a bezel," which is required by Claim 12. Instead, the Petition merely appears to address that display of the embodiment of Markel's Figure 15 includes a bezel. The Petition does not even identify whether the electrodes identified in its annotated version of Figure 15 is the claimed "first portion of the enclosure" or the claimed "first pad." Pet., 62.

188. For at least the reasons discussed above, Ground 2 fails with respect to Claim 12.

5. *The proposed mappings of the combination of Markel with Mills to the '257 Patent fail to provide all elements of claim 13*

189. In addition to the above deficiencies, including that Masimo fails to demonstrate that all the elements of Claim 1 are met by Mills+Markel, and therefore Claim 13 which depends from Claim 1 is also invalid, the both Mr. Oslan and the Petition also fail to demonstrate that Mills+Markel provides the additional disclosures of Claim 13.

190. The Petition provides an analysis of Claim 13 that fails for similar reasons that I discussed with respect to Claim 12, above. In particular, in its analysis of Claim 1, the Petition states that the claimed "second portion of the enclosure" is disclosed by either the region around electrode 420b or alternatively to electrode 420b itself in Markel. Pet., 50. Yet, similar to Claim 12, in analyzing Claim 13, Masimo abandons these mappings and instead broadly claims that the display of a different embodiment of Markel includes a bezel having electrodes. Pet., 63. For at least these reasons, the Petition fails to demonstrate that the proposed combination provides Claim 13.

C. Masimo's Analysis of Claim 15 Improperly Mixes Different Embodiments of Markel

191. In the Petition, the analysis of Claim 15 improperly combines different embodiments of Markel based on completely different classes of computing devices without providing sufficient rationale to combine the teachings

of the prior art reference's different embodiments and explaining sufficiently *why* one skilled in the art would have found it obvious to combine those teachings. For example, Markel makes clear that the embodiments shown in FIGs. 1-10 describe "various aspects of…a mobile communication device" before transitioning to a discussion of the embodiments in FIGs. 11-15 which relate to a general computing device such as "a desktop computer, laptop or notebook computer." EX1005, [0060]-[0062].

192. For example, in addressing Element 15[c(i)], the Petition references the mobile device embodiments of Markel depicted in FIGs. 4-5. Pet., 66-68. Yet in addressing Element 15[c(iii)], after briefly mentioning that Figure 1 shows that the mobile device includes a display, the Petition abruptly moves on to the general computing device embodiment of Figure 15 as allegedly providing the claimed "second lead embedded in the display screen. Pet., 75-76. However, unlike the embodiments shown in Markel's FIGS. 4 and 5, the device shown in Figure 15 is neither a cellular nor a portable telephone. To be clear, FIGs. 1 and 4-5 are all part of Markel's mobile device embodiment in which the small form factor of the device means that the mobile device includes a relatively small display. EX1005, Figure 1. By contrast, Figure 15 describes an embodiment of Markel describing a desktop or laptop computer, which a POSITA would have recognized as having a significantly larger display screen than the mobile device disclosed by Markel's

earlier embodiments. EX1005, [0060]-[0062], [0078]. Indeed, Markel is clear that "FIG. 15 is a diagram illustrating an exemplary ***computer*** display device" not a component of a mobile device. EX1005, [0078]. A POSITA would have known that computing devices such as desktop and laptop computers at that time either included or were connected to display screens having a significantly larger profile than those of mobile devices that were designed to fit into the pocket of a user (such as the mobile Device of FIGs. 1-10). Markel makes no mention of including electrodes embedded in the screen of any of its mobile device embodiments.

193. Despite these distinctions, the Petition does not even acknowledge its use of disclosures from vastly different embodiments of two distinct devices having significantly different display screen sizes. Masimo provides no explanation of why a POSITA would have been motivated to combine these embodiments. For example, Masimo fails to explain how a POSITA would have, when considering a potential combination of these different embodiments, dealt with complications resulting from differences in size and shape of a telephone display in comparison to a computer display device. Nor does Masimo provide any analysis or evidence to demonstrate that a POSITA would have had a reasonable expectation of success in resizing the electrode 1540 positioned on the display screen of Figure 15's to fit within the significantly smaller display screen of Markel's mobile device embodiments or that such a configuration would have

been operable. For these reasons, Ground 2 fails with respect to Claim 15 and its dependent claims.

D. The Petition Fails to Demonstrate that the Combination of Markel with Mills Provides Additional Elements of the Claims Depending from Independent Claim 15

194. In addition to the above described deficiencies off the combination of Markel with Mills with respect to claim 15, Masimo and Mr. Oslan fail to demonstrate that the combination of Markel with Mills discloses all elements of several of the dependent claims that depend from claim 15. I address these claims below and the deficiencies in the Petition below.

1. The proposed mappings of the combination of Markel with Mills to the '257 Patent fail to provide all elements of claim 19

195. In addition to the above deficiencies, including that Masimo fails to demonstrate that all the elements of Claim 1 are met by Mills+Markel, and therefore Claim 19 which depends from Claim 1 is also invalid, the both Mr. Oslan and the Petition also fail to demonstrate that Mills+Markel provides the additional disclosures of Claim 19.

196. Similar to the analysis that I provided with respect to claim 12, above, Masimo's analysis of Claim 19 also fails. Claim 19 recites, in part, that "***the*** first portion of the electronic device comprises a bezel of the enclosure." In its analysis of Claim 15 (from which Claim 19 depends), Masimo identifies the region of

Markel's enclosure surrounding electrode 410b as allegedly mapping to the claimed "first portion." Pet., 67. With respect to Figure 5 of Markel, Masimo alternatively identifies the button onto which electrode 510 is positioned and the back surface onto which electrode 520 is positioned as allegedly reading on the claimed "first portion." *Id.*, 67-68.

197. Yet, as with Claim 12, in analyzing Claim 19, Masimo abandons these earlier proposed mappings and broadly argues that the display described in a different embodiment of Markel includes a bezel having electrodes. Pet., 80-81. The Petition fails to identify how any of the portions of Markel's device on which electrodes 410b, 510, or 520 are positioned are "a bezel." At most, Masimo has demonstrated that the display of the embodiment of Markel's Figure 15 includes a bezel. The Petition fails to even identify whether Masimo is reading the electrodes identified in its annotated version of Figure 15 on the claimed "first portion of the enclosure" or the claimed "first pad." Pet., 80-81.

198. The Petition then references yet another completely different embodiment (Figure 2) having electrodes positioned on buttons of the device (not the display) as allegedly providing the claimed "non-conductive component positioned between the bezel and the display screen for electrically isolating the first lead from the second lead." Pet., 80-81. But nothing in the Petition explains

how this embodiment would be integrated with the embodiments of Figure 15, 4, and 5.

199. Masimo simply has not described how its mapping of the combination of Markel and Mills to Claim 15 demonstrates that "the first portion of the electronic device comprises a bezel of the enclosure" nor has Masimo identified how its mapping in its analysis of Claim 19 provides all elements of Claim 15. The mapping found in the Petition are inadequately incomplete.

200. Masimo has failed to do so with respect to Claim 19 and therefore the Ground 2 fails with respect to Claim 19.

2. The proposed mappings of the combination of Markel with Mills to the '257 Patent fail to provide all elements of claim 20

201. In addition to the above deficiencies, including that Masimo fails to demonstrate that all the elements of Claim 1 are met by Mills+Markel, and therefore Claim 20 which depends from Claim 1 is also invalid, the both Mr. Oslan and the Petition also fail to demonstrate that Mills+Markel provides the additional disclosures of Claim 20.

202. When analyzing claim 15, from which claim 20 depends, Masimo provides several alternative mappings of what components of the combination of Markel and Mills provide the claimed "first lead embedded in a first portion of the enclosure" of Element 15[c(i)]. Pet., 66-73. For instance, Masimo alternatively

maps each of electrode 410b of Figure 4 and electrodes 510 and 520 of Figure 5 of Markel as reading on the claimed first lead. Pet., 67-68. Each of these mappings fails to provide detection of the first electrical signal "via the user's contact ***with the first portion of the enclosure***," as required by claim 20. In each of these mappings, Masimo maps the electrodes 410b, 510, and 520 on the claimed 'first lead," but not the "first portion of the enclosure" even though the electrodes 410b, 510, and 520 are embedded in the "first portion of the enclosure." According to Markel's disclosure, the electrical signal is detected via "electrode contact with a user's hand," not contact with the surrounding enclosure in which the electrodes are embedded. EX1005, [0043], [0049]-[0050]. Thus, in Masimo's mappings of electrodes 410b, 510, and 520 to the claimed "first lead," the electrical signal is detected through the user's contact with the electrode/lead, and not through "contact ***with the first portion of the enclosure,***" as recited by claim 20. For at least these reasons, the mappings proposed in the Petition fail to provide claim 20.

203. In its analysis of Element 15[c(i)], Masimo provides yet another alternative mapping, mapping the top of Mills' leaf-spring 62 to the claimed first lead while identifying "the electrodes 410b, 420b of Markel" as part of the enclosure in this mapping. Pet., 71-73. However, as I previously discussed, in this mapping, the top of the leaf-spring 62 is not "embedded in" the electrode. Instead, the top of the leaf-spring 62 is "placed…against" an inner surface of electrode

410b. Thus, this mapping fails to provide Element 15[c(i)] and therefore cannot be relied upon to meet the limitations of Claim 20. Pet., 48. For at least these reasons, the Petition fails to demonstrate that the combination of Markel and Mills provides the limitations of claim 20.

E. The Petition Fails to Demonstrate that a POSITA Would Have Applied Mills to Markel in the Proposed Manner

204. For multiple reasons, the Petition provides a proposed combination of Markel and Mills that is flawed: First, hindsight is the basis of Masimo's proposed combination. Second, Masimo does not provide adequate details regarding its proposed combination device. Third, Masimo does not demonstrate that a POSITA would have had a reasonable expectation of success in combining the disclosures of Markel and Mills, as proposed in the Petition.

205. The Petition states, without any supporting evidence, that "[i]t would have been obvious to incorporate the pad (leaf spring 62) teachings of Mills into the device of Markel." Pet., 47. Mr. Oslan states in his declaration that "[a] POSITA seeking to implement Markel's device would look to Mill's [*sic*] disclosure for ways to internally connect the electrodes of Markel to internal electronic components using pads," but then provides no evidence to support his statement. EX1003, ¶109. And yet this is the basis for the Petition's subsequent statement that "a POSITA would utilize the leaf spring 62 taught by Mills to

connect the electrodes 410b, 420b of Markel to internal processing components taught by Markel." *Id*.

206. But in reaching this conclusion, Mr. Oslan did not present any evidence that would suggest a motivation other than retrospective reconstruction of the claims. This is especially evident because the purported motivation is merely a suggestion recited in the Petition that a POSITA *could* have combined teachings of the two references, rather than a demonstration that the POSITA actually *would* have combined the teachings of the two references.

207. For example, Mr. Oslan's entire rationale for inserting the leaf spring of Mills into the device of Markel is that a POSITA would not know how to connect the electrodes and the inner processing components, such as the Cardiac Info Acquisition Module and Cardia Info Processing Module, absent the teachings of Mills. However, this argument is directly contradicted by the fact that both Mr. Oslan and the Petition assert that Markel *does* disclose how to connect the external electrodes to the internal processing components of Markel's device using connectors:

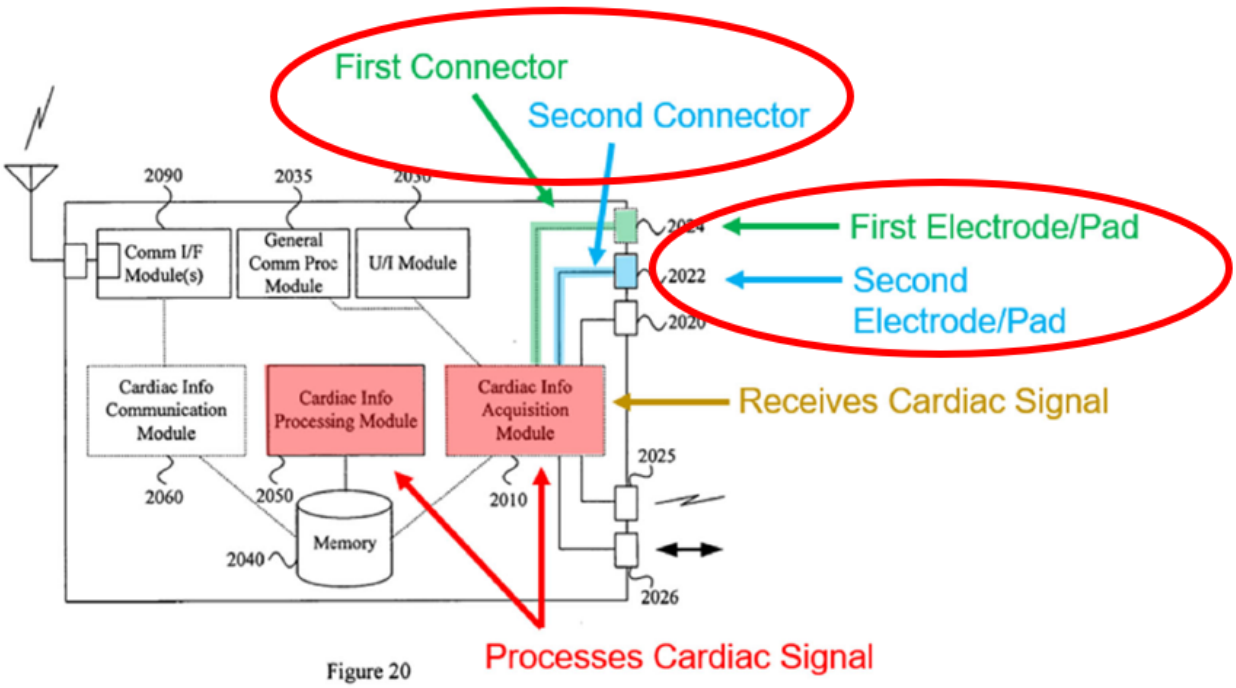


Figure 20

Pet., 53; EX1003, ¶¶91-92.

208. As shown in this annotated version of Markel's Figure 20, Markel's device includes wires for connecting the external electrodes to the internal processing components. Indeed, a POSITA would have been aware of this straight forward and extremely common option for connecting internal components of an electronic device such as the handheld cellular phone of Markel. The assessment of Mr. Oslan that a POSITA would need to turn to Mills to figure out how to connect an electrode of a mobile device to internal circuitry of the device is not based on any actual lack of knowledge on the part of POSITA of how to implement such connections, but rather based solely on a hindsight reconstruction of the claims of the '257 Patent.

209. The combination of Markel with Mills, and the justification for combining the two references in the proposed manner, articulated by both Dr. Oslan and Masimo overlooks the nearly ubiquitous use of thin flexible cables, including multi-lead cables, for connections between elements of a compact consumer electronic product. In fact, the connections that can be provided by male-to-female pins and receptacles at the ends of thin flexible cables are generally considered to be highly-reliable over the life of a product, and not subject to vibrations or other physical phenomena that might temporarily or permanently disable a leaf spring structure. Finally, by the time of the critical date of the '257 patent, the dimensions of these flexible cable connectors had been reduced to the extent that they were easily accommodated in successful consumer electronics products, instead of leaf-spring contacts, which can take up a lot of area within the device for each individual contact. The fact that space within such devices was in extremely high demand and that conservation of such space of the utmost important in designing such devices would have advised that the simple, well-known, and reliable option of a flexible cable or wire would have been the obvious choice in implementing Markel's device. Indeed, a POSITA would have recognized that Markel didn't provide the details on such connectors because they were so well-known and common that they were clearly the obvious choice for implementing Markel's device. Therefore, a POSITA would appreciate that thin

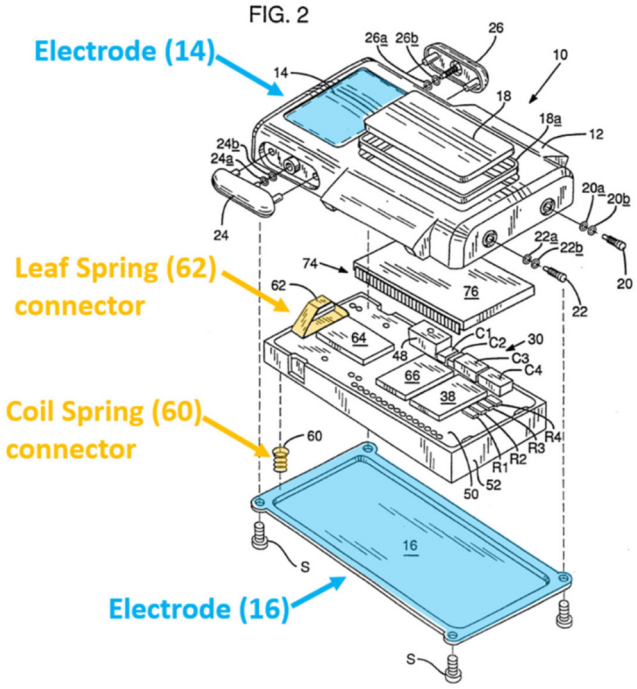
flexible cables are the preferred choice for making electrical connections between elements of an electronic product such as that disclosed by Markel.

210. There is simply no real justification in Mr. Oslan's declaration (or the Petition) to demonstrate why a POSITA actually *would* incorporate the leaf spring 62 of Mills into Markel's device rather than a mere hindsight inspired assertion that a POSITA *could* make such a modification. EX1003, ¶86. The proposed combination appears to be motivated by no reasoning other than a desire to reach the claims of the '257 Patent.

211. Furthermore, the Petition relies upon Mr. Oslan's declaration, which only reproduces its arguments that are unsupported by any evidence. Mr. Oslan's lack of corroborating evidence to support the proposed combination indicates that the proposed combination is based on nothing other than retrospective reconstruction or hindsight.

212. Additionally, there are significant differences between the positioning of the electrodes of Markel as compared to those of Mills that make the addition of Mills leaf spring 62 into Markel's device more than "a mere rearrangement of known mechanical components in known ways in a complementary device," as argued in the Petition. Pet., 48. By ignoring those differences, the Petition fails to adequately describe how the particular forms of connections that are described in Mills could be applied to Markel.

213. As illustrated in Figure 2 of Mills, the two electrodes 14 and 16 are located on opposite sides of a frontal plane of housing 12, and PCB 50 is oriented parallel to the frontal plane as well as the planes of the two electrodes. Markel's Figure 4, however, shows a substantially different configuration than the configuration described in Mills. For instance, Mills shows that a "first electrode [is] placed on the left side portion 410…, and a second electrode [is] placed on the right side portion 420." EX-1005, [0045]. Thus, contrary to the argument provided in the Petition, more than "a mere rearrangement of known mechanical components in known ways in a complementary device" would be required to use "the leaf spring 62 taught by Mills to connect the electrodes 410b, 420b of Markel to internal processing components taught by Markel." Petition, 47-48.



Pet., 46.

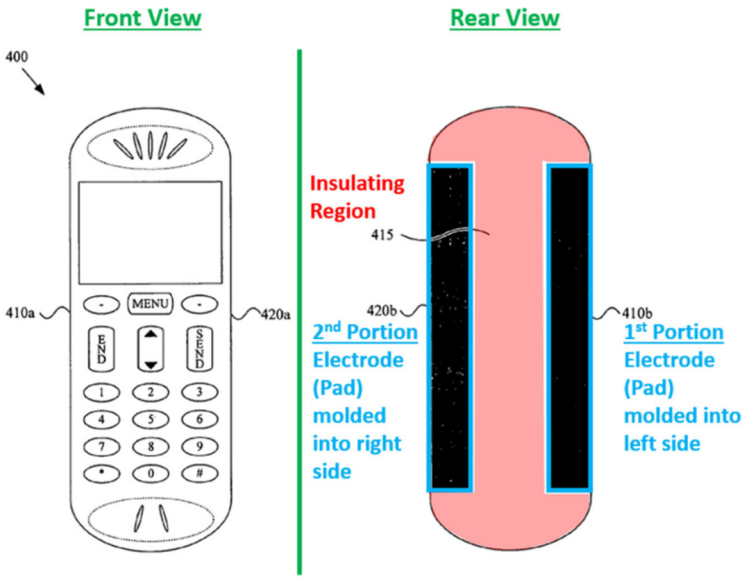


Figure 4

Pet., 43.

214. It is notable that Mills teaches a configuration in which all of its electrodes 14 and 16, the leaf spring 62's top surface, and the PCB 50 are formed on *parallel* planes. Those parallel planes are different frontal planes that are *perpendicular to a side plane that extends along the width of Mills device*. *See* Figure 2 of Mills above.

215. The Petition states that "[a] POSITA seeking to implement Markel's device would look to Mill's [*sic*] disclosure for ways to internally connect the electrodes of Markel to internal electronic components using pads." Petition, 47. Applying that logic, a POSITA following Mills' configuration would have positioned Markel's electronic components on a PCB, and, further, would have

positioned the PCB in between the two electrodes 410b/420b of Markel. Based on Mills, the POSITA would have also placed the PCB in *parallel to the two electrodes* to supposedly connect the electrodes to the PCB by leaf springs similar in one Masimo cited from Mills' configuration. However, in such a modified configuration of Markel, the PCB would be in parallel to—not perpendicular to—the width side of Markel's device 400. But this kind of configuration would deviate from Mills' configuration, which shows that the PCB plane is positioned perpendicular to the width side of Mills' device.

216. Additionally, the above-described orientation of the PCB plane in the proposed modified Markel device would necessitate a width dimension increase in Markel's device to enable enclosure of the PCB between the front and the rear surfaces of the device. However, this would result in the "cumbersome and inconvenient" bulky device that Markel trying to avoid. *See* EX-1005, [0002]. Also, if PCB were perpendicular to the front and rear surfaces (and parallel to the side electrodes), this would complicate the electrical connections of the PCB to user-interface components (e.g., bottoms, display, etc.) implemented on the front surface of Markel's device 400. *See* EX-1005, [0034] (naming example components implemented on the front surface of the device, including display 140, speaker 142, and buttons 130-138).

217. Alternatively, if a POSITA orients the PCB to be perpendicular to the width side (i.e., parallel to the front and rear surfaces) of Markel's device, the POSITA would require further details—beyond what is provided in Mills' disclosure— on how to connect Markel's electrodes 410b/420b to the PCB that is oriented perpendicular to the width side.

218. For the additional reasons that I have explained above, Ground 2 fails to demonstrate all elements of claims 1-4 and 8-22 are provided by Markel in view of Mills.

VIII. LEGAL PRINCIPLES

A. Anticipation

219. I have been informed that a patent claim is invalid as anticipated under 35 U.S.C. § 102 if each and every element of a claim, as properly construed, is found either explicitly or inherently in a single prior art reference. Under the principles of inherency, if the prior art necessarily functions in accordance with, or includes the claimed limitations, it anticipates.

220. I have been informed that a claim is invalid under 35 U.S.C. § 102(a) if the claimed invention was known or used by others in the U.S., or was patented or published anywhere, before the applicant's invention. I further have been informed that a claim is invalid under 35 U.S.C. § 102(b) if the invention was patented or published anywhere, or was in public use, on sale, or offered for sale in

this country, more than one year prior to the earliest effective filing date of the patent application (*i.e.*, the Critical Date). And a claim is invalid, as I have been informed, under 35 U.S.C. § 102(e), if an invention described by that claim was described in a U.S. patent granted on an application for a patent by another that was filed in the U.S. before the date of invention for such a claim.

B. Obviousness

221. I have been informed that a patent claim is invalid as "obvious" under 35 U.S.C. § 103 in light of one or more prior art references if it would have been obvious to a POSITA, taking into account (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so called "secondary considerations" of non-obviousness, which include: (i) "long felt need" for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results of the claimed invention, and (iv) "copying" of the claimed invention by others. For purposes of my analysis above and because I know of no indication to the contrary, I have applied the Critical Date as the date of invention in my above analyses, although in many cases the same analysis would hold true even at an earlier time than the Critical Date.

222. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. To be obvious in light of a

single prior art reference or multiple prior art references, there must be a reason to modify the single prior art reference, or combine two or more references, in order to achieve the claimed invention. This reason may come from a teaching, suggestion, or motivation to combine, or may come from the reference or references themselves, the knowledge or "common sense" of one skilled in the art, or from the nature of the problem to be solved, and may be explicit or implicit from the prior art as a whole. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

IX. CONCLUSION

223. I reserve the right to supplement my opinions to address any information obtained, or positions taken, based on any new information introduced throughout this proceeding.

224. I declare under penalty of perjury that the foregoing is true and accurate to the best of my ability.

APPENDIX A

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Education

- University of California, Berkeley
  Ph D Physics June 1989
- University of Minnesota, Minneapolis
  BS Physics March 1983

Experience

Senior Associate Dean of Engineering for Student Affairs, Stanford. 7/15-present.

Director, Founder, recent CEO, BoD Member, Applaud Medical 11/14-present.

- Non-invasive therapy for Kidney Stones using unfocused energy and Acoustic Enhancer
- Appointed as CEO 2/2020, leading effort to launch Pivotal FDA Clinical Trial.

Founder, Member, Board of Directors, Chair of Technical Advisory Board, SiTime 8/04-11/14

- CMOS-Compatible MEMS Resonators for Electronic Products.
- SITM on Nasdaq, >$2B Market Cap, World-leading supplier of MEMS-based oscillators

CTO and Founder Cooligy, 6/02-3/05

- Liquid cooling of microprocessors and other high power-density electronic devices.

Program Manager, DARPA Microsystems Technology Office, 10/06-10/10

- Launched $250M program on Nanotechnology, Thermal Management and Nanomanufacturing.

Professor, Department of Mechanical Engineering, Stanford University, 1/94-Present

- Leading Micromechanical Systems Research Group, with emphasis on development of high-performance microsensors, and measurements of fundamental properties of microstructures.
- Active research in Micromechanical Resonators for Time References, Encapsulated Inertial Sensors, Optimal Design of MEMS Structures, Wafer-Scale Packaging of MEMS Devices.
- Teaching Mechatronics, Sensors and Measurement, and others

Staff Scientist, Technical Group Leader, Jet Propulsion Laboratory, 7/89-1/94.

- Led the design, construction, and characterization of novel micromachined Si infrared detectors magnetometers and accelerometers based on a novel displacement transducer.
- Participated in development of meterological instrumentation (pressure, wind, temperature, humidity,...), seismological instrumentation, deformable optical elements, instrumented neurological probes, soil chemistry apparatus, calibration parts for space telescopes,...

Research Assistant, Physics Department, University of California, Berkeley. 1/84-7/89.

- Measured of the heat capacity of ^{4}He submonolayers on metallic films, showing them to be in a 2-dimensional Bose gas phase, in contradiction to similar measurements on other substrates.

Honors

• Recipient	Elected to the National Academy of Engineering	2/22
• Recipient	Stanford Presidential Award for Excellence in Diversity	6/19
• Recipient	Tau Beta Pi Teaching Honor Roll	6/19
• Recipient	IEEE Daniel Noble Award for Emerging Technologies	9/18
• Recipient	IEEE Sensors Council Technical Achievement Award	9/11
• Winner	Coed Ultimate Frisbee National and World Champion	11/98, 11/99
• Recipient	NSF CAREER Award	7/95
• Recipient	R+D 100 Award	5/93
• Recipient	Distinguished Teaching Award	6/89
• Recipient	AT&T Bell Laboratories Fellowship	8/86-6/89

Litigation Experiences

- 2022 retained as Expert Witness by Apple to prepare IPR responses and declarations for patents related to noise cancellation. Two of these cases has been instituted for IPR, and others are pending decision. There have been reports, settlements and joinders involving multiple parties, with the current clients being Sony, Meta and LG.

- 2021 retained as Expert Witness by Apple for IPR challenge of a pair of patents describing use of inertial sensors for monitoring of posture and movement of humans for diagnostics and training. Reports were prepared, and the board recently ruled all claims of both patents invalid.

- 2020 retained as Expert Witness by Apple in multiple patents related to design of optical physiological monitors. IPRs were initially instituted against all thirteen challenged patents. Subsequent work included preparation and submission of reports and responses, and numerous depositions. In a string of final written decisions that issued from February through May 2022, the patent board invalidated all but one challenged claim of the thirteen patents, subsequent appeals were recently resolved. There is ongoing work here related to more recent patent challenges by both sides.

- 2019 retained as Expert witness in case related to wearable baby monitors, including motion and temperature sensors. Case settled during drafting of expert infringement report.

- 2018, retained as Expert witness by attorneys representing Apple in a case related to algorithms for sensing motion and other physiological parameters in wearable devices,. Case settled after going on hold for IPR evaluation of IP.

- 2016, Expert Witness in case involving optical proximity sensors in smartphones. I was retained by HTC America and Capella, who were defendants in the case. I was compensated by defendants for work involving Invalidity and Non-Infringement reports, and was deposed after expert reports on invalidity and non-infringement. This case settled just a few weeks before trial in march 2017. This was Case Action No. 2:15-cv-1524-JRG in Marshall Texas.

- 2015, Expert Witness in Mayfonk –vs- Nike patent infringement suit brought by Mayfonk. I prepared expert reports on validity and non-infringement. The case settled just before depositions were taken. I was compensated by Nike for this work. This was case # Civil No.3:14-cv-00423-MO in the District of Oregon.

- 2013-2014, Expert Witness in ST Microelectronics –vs- Invensense patent infringement suit brought in the ITC by ST. I assisted in claim construction, prepared expert reports on claim construction, validity and infringement, and provided deposition testimony. This case settled after opening statements. I was compensated by Invensense for this work. This was ITC Investigation # 337-TA-876.

- 2011-2012, Expert Witness in St. Jude Medical-vs-Volcano Corp patent infringement suit and counter suit. Assisted in claim construction, prepared expert reports, provided deposition testimony and trial testimony. I was compensated by Volcano Corporation for this work.

- 2011, Retained by Maxim Integrated Systems to examine documents and prepare opinions as to the value of certain documents in the possession of former employees of ST Microelectronics. I was compensated by Maxim for this work. This was Italian proceeding Rg. 50253/2011.

Books :

J.E. Carryer, M.Ohline and T.W. Kenny, "Introduction to Mechatronic Design", Pearson (2011).

Refereed Journal Publications:

1. J. Sun, S. Yu, H. Zhang, D. Chen, X. Zhou, C. Zhao, **D.D. Gerrard, H-K Kwon, G. Vukasin**, D. Xiao, T.W. Kenny, X. Wu, A. Seshia, "Generation and Evolution of Phononic Frequency Combs via Coherent Energy Transfer Between Mechanical Modes", Physical Review Applied 19, 014031 (2023)

2. G. Margiani, S. Guerrero, T.L Heugel, C. Marty, R. Pachlatko, T. Gisler, **G.D. Vukasin, H-K. Kwon, J.M.L. Miller, N.E. Bousse,** T.W. Kenny, O. Zilberberg, D. Sabonis, A. Eichler, "Extracting the Lifetime of a Synthetic 2-Level System", Applied Physics Letters 121, 164101 (2022).

3. **N.E. Bousse,** S.E. Kuenstner, **J.M.L. Miller, H-K. Kwon, G.D. Vukasin,** J.D. Teufel, and T.W. Kenny, "Dispersive Readout of a High-Q Micromecanical Resonator", Applied Physics Letters 121, 73503 (2022).

4. **J.M.L. Miller, G.D. Vukasin,** Z. Zhang, **H-K. Kwon**, A. Majumdar, T.W. Kenny, and S.W. Shaw, "Effect of Remote Boundary Conditions on Clamping Loss in Micromechanical Resonators", JMEMS 3, 204 (2022).

5. **J.M.L. Miller, A. Gomez-Franco, D.D. Shin, H-K Kwon**, and T.W. Kenny, "Amplitude stabilization of micromechanical oscillators using engineered nonlinearity" Physical Review Research 3, 033268 (2021).

6. S. Shin, **H-K Kwon, G.D. Vukasin**, T.W.Kenny and F. Ayazi, "A temperature compensated biaxial eFM accelerometer in Epi-seal process" Sensors and Actuators A 330, 112860 (2021).

7. Y. Wang, Y.W. Lin, **J. Glaze, G.D. Vukasin, D.D. Shin, Hyun-Keun Kwon, D.B. Heinz, Y. Chen, D.D. Gerrard**, T.W. Kenny, Andrei M Shkel, "Quantification of Energy Dissipation Mechanisms in Toroidal Ring Gyroscope", JMEMS 30, 193 (2021).

8. J.S. Katz, C. Zhang, M.T. Barako, **H.J.K. Kim**, M. Asheghi, T.W. Kenny, and K.E. Goodson, "Bicontinuous Mesoporous Metal Foams with Enhanced Conductivity and Tunable Pore Size and Porosity via Electrodeposition for Electrochemical and Thermal Systems", ACS Appl. Nano Mater. 2020, 3, 12, 12408 (2020)

9. V. Zega, G. Gattere, **S. Koppaka, A. Alter, G.D. Vukasin**, A. Frangi, and T.W. Kenny, "Numerical Modelling of Non-Linearities in MEMS Resonators", JMEMS 29, 1443 (2020).

10. **A.L. Alter, I.B. Flader, Y. Chen, L.C. Ortiz, D.D. Shin**, and T.W. Kenny, "Characterization of Accelerated Fatigue in Thick Epi-Polysilicon Vacuum Encapsulated MEMS Resonators", JMEMS 29, 1483 (2020).

11. J.S. Katz, C. Zhang, M.T. Barako, **H.J.K. Kim**, M. Asheghi, T.W. Kenny, and K.E. Goodson, "Bicontinuous Mesoporous Metal Foams with Enhanced Conductivity and Tunable Pore Size and Porosity via Electrodeposition for Electrochemical and Thermal Systems", ACS Appl. Nano Mater. 2020, 3, 12, 12408 (2020)

12. V. Zega, G. Gattere, **S. Koppaka, A. Alter, G.D. Vukasin**, A. Frangi, and T.W. Kenny, "Numerical Modelling of Non-Linearities in MEMS Resonators", JMEMS 29, 1443 (2020).

13. **A.L. Alter, I.B. Flader, Y. Chen, L.C. Ortiz, D.D. Shin**, and T.W. Kenny, "Characterization of Accelerated Fatigue in Thick Epi-Polysilicon Vacuum Encapsulated MEMS Resonators", JMEMS 29, 1483 (2020).

14. **J.M.L. Miller**, H. Zhu, S. Sundaram, **G.D. Vukasin, Y. Chen, I.B. Flader, D.D. Shin**, and T.W. Kenny, "Limits to Thermal-Piezoresistive Cooling in Silicon Micromechanical Resonators", JMEMS 29, 677 (2020).

15. **H.K. Kwon, G.D. Vukasin, N.E. Bousse,** and T.W. Kenny, "Crystal Orientation Dependent Dual Frequency Ovenized MEMS Resonator With Temperature Stability and Shock Robustness", JMEMS 29, 1130 (2020).

16. **G.D. Vukasin, V.K. Sanchez, J. Glaze, N.E. Bousse**, N. Bissel, **D.D. Shin, H.K Kwon, D. Heinz,** E.T-T Yen, and T.W. Kenny, "Anchor Design Affects Dominant Energy Loss Mechanism in a Lamé Mode MEM Resonator", JMEMS 29, 860 (2020).

17. **J.M.L. Miller, D.D. Shin, H.K. Kwon**, S.W. Shaw, and T.W. Kenny, "Spectral narrowing of parametrically pumped thermomechanical noise", Applied Physics Letters 117, 033504 (2020).

18. **A.L. Alter, I.B. Flader, Y. Chen, D.D. Shin**, and T.W. Kenny, "Nonlinear Dissipation in Epitaxial SCS and Polysilicon MEMS Driven at Large Amplitudes", JMEMS 29, 1118 (2020).

19. **N.E. Bousse, J.M.L Miller, A.L. Alter, C.P. Cameron, H.K. Kwon, G.D. Vukasin**, and T.W. Kenny, "Negative Nonlinear Dissipation in Microelectromechanical Beams", JMEMS 29, 954 (2020).

20. **A.L. Alter, D.D. Gerrard, H.K. Kwon, G.D. Vukasin**, and T.W. Kenny, "Quality Factor Extraction and Enhancement Across Temperature in Ring Resonators", JMEMS 29, 1124 (2020).

21. Z. Mohammadi, T.L. Heugel, **J.M.L. Miller, D.D. Shin, H.K. Kwon**, T.W. Kenny, R. Chitra, Oded Zilberberg, and L.G. Villanueva, "On the effect of linear feedback and parametric pumping on a resonators frequency stability", arXiv preprint arXiv:2006.00650 (2020).

22. **L.C. Ortiz, H.K. Kwon, J. Rodriguez, Y. Chen, G.D. Vukasin, D.B. Heinz, D.D. Shin**, and T.W. Kenny, "Low-Power Dual Mode MEMS Resonators With PPB Stability Over Temperature", JMEMS 29, 190 (2020).

23. **N.E. Bousse, J.M.L. Miller, H.K. Kwon, G.D. Vukasin**, and T.W. Kenny, "Quality factor tuning of micromechanical resonators via electrical dissipation", Applied Physics Letters 116, 023506 (2020).

24. X. Zhou, C. Zhao, D. Xiao, J. Sun, G. Sobreviela, **D.D. Gerrard, Y. Chen, I. Flader**, T.W. Kenny, X. Wu, and A.A. Seshia, "Dynamic modulation of modal coupling in microelectromechanical gyroscopic ring resonators", Nature Communications 10, 1 (2019).

25. **J.M.L. Miller, D.D. Shin, H.K. Kwon**, S.W. Shaw, and T.W. Kenny, "Phase Control of Self-Excited Parametric Resonators", Physical Review Applied 12 (4), 044053 (2019).

26. **J.M.L. Miller, N.E. Bousse, D.B. Heinz, H.J. Kim, H.K. Kwon, G.D. Vukasin** and T.W. Kenny, "Thermomechanical-Noise-Limited Capacitive Transduction of Encapsulated MEM Resonators", JMEMS 28, 965 (2019).

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28. **I.B. Flader, Y. Chen, Y. Yang, E.J. Ng, D.D. Shin, D.B. Heinz, L. Comenencia Ortiz, A.L Alter**, W. Park, K.E. Goodson, T.W. Kenny, "Micro-Tethering for Fabrication of Encapsulated Inertial Sensors with High Sensitivity", JMEMS 28, 372 (2019).

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30. **J. Rodriguez**, S.A.Chandorkar, C.A. Watson, G.M, Glaze, **C.H. Ahn, E.J. Ng, Y. Yang**, T.W. Kenny, "Direct Detection of Akhiezer Damping in a Silicon MEMS Resonators", Scientific Reports 9, 2244 (2019).

31. **J.M.L. Miller**, A. Ansari, **D.B. Heinz, Y. Chen, I.B. Flader, D.D. Shin**, L.G. Villanueva and T.W. Kenny, "Effective Quality Factor Tuning Mechanisms in Micromechanical Resonators", Applied Physics Reviews 5, 041307 (2018).

32. **J.M.L. Miller**, H. Zhu, **D.B. Heinz, Y. Chen, I.B. Flader, D.D. Shin**, J.E-Y. Lee, T.W. Kenny, "Thermal-Piezoresistive Tuning of the Effective Quality Factor of a MicroMechanical Resonator", Physical Review Applied, 10, 044055 (2018).

33. **J. Rodriguez**, S.A.Chandorkar, G.M, Glaze, **D.D. Gerrard, Y. Chen, D.B. Heinz, I.B. Flader**, T.W. Kenny, "Direct Detection of Anchor Damping in MEMS Tuning Fork Resonators", JMEMS 27, 1 (2018).

34. M. Mellema, W. Behnke-Parks, A. Luong, M. Hopcroft, Claire Mills, S. Ho, R. Hsi, D. Laser, T. Kenny, R. Grubbs, M. Stoller, "Absence of Ureteral/Renal Injury Following Low-Intensty Extracorporeal Acoustic Energy Lithotripsy with Stone-Targeting Microbubbles in an in-vivo Swine Model", The Journal of Urology 199,4 pe479, (2018).

35. **L. Comenencia Ortiz, D.B. Heinz, I.B. Flader, A.L. Alter, D.D. Shin, Y. Chen** and T.W. Kenny, "Assessing failure in epitaxially encapsulated micro-scale sensors using micro and nano x-ray computed tomography", MRS Communications 8, 275 (2018).

36. M.T. Barako, **T.S. English**, S. Roy-Panzer, T.W. Kenny and Kenneth E Goodson, "Dielectric barrier layers by low-temperature plasma-enhanced atomic layer deposition of silicon dioxide", Thin Solid Films 649, 24 (2018).

37. **Y. Chen, I.B. Flader, D.D. Shin, C.H. Ahn, J. Rodriguez** and T.W. Kenny, "Robust Method of Fabricating Epitaxially Encapsulated MEMS Devices with Large Gaps", JMEMS 26, 1235 (2017).

38. W. Park, **D.D. Shin**, S.J. Kim, J.S. Katz, J. Park, **C.H. Ahn**, T. Kodama, M. Asheghi, T.W. Kenny, K.E. Goodson, "Phonon Conduction in Silicon Nanobeams", Appl, Phys. Lett. 110, 213102 (2017).

39. F. Purkl, A.Daus, **T. English**, J Provine, A. Feyh, G. Urban, T. Kenny, "Measurement of Young's modulus and residual stress of atomic layer deposited Al2O3 and Pt thin films", J. Micromech. Microeng. 27, 085008 (2017)

40. G.Agarwal, T. Kazior, T. Kenny, D. Weinstein, "Modeling and analysis for thermal management in Gallium Nitride HEMTs using microfluidic cooling", Journal of Electronic Packaging 139, 11001 (2017).

41. J. Atalaya, T.W. Kenny, M.L Roukes, M.I Dykman, "Nonlinear damping and dephasing in nanomechanical systems", Physical Review B, 94, 15440 (2016).

42. O. Shoshani, **D. Heywood, Y. Yang**, T.W. Kenny, and S.W. Shaw, "Phase Noise Reduction in an MEMS Oscillator Using a Nonlinearly Enhanced Synchronization Domain", JMEMS 25 (2016).

43. **Y. Yang, E.J. Ng,** P.M. Polunin, **Y.Chen, I.B. Flader**, S.W. Shaw, M.I. Dykman, and T.W. Kenny, "Nonlinearity of Degenerately Doped Bulk-Mode Silicon MEMS Resonators", JMEMS 25, 859 (2016).

44. **T.S. English**, J Provine, A.F. Marshall, A.L. Koh, T.W. Kenny, "Parallel preparation of plan-view transmission electron microscopy specimens by vapor-phase etching with integrated etch stops", Ultramicroscopy 166, 39 (2016).

45. **Y. Yang, E.J. Ng, Y. Chen, I.B. Flader**, T.W. Kenny, "A Unified Epi-Seal Process for Fabrication of High-Stability Microelectromechanical Devices", JMEMS 25, 489 (2016).

46. **D.B. Heinz, V.A. Hong, C.H. Ahn, E.J. Ng, Y. Yang**, and T.W. Kenny, "Experimental Investigation into Stiction Forces and Dynamic Mechanical Anti-Stiction Solutions in Ultra-Clean Encapsulated MEMS Devices", JMEMS 25, 469 (2016)

47. P.M. Polunin, **Y. Yang**, M.I. Dykman, T.W. Kenny, and S.W. Shaw, "Characterization of MEMS Resonator Nonlinearities Using the Ringdown Response", JMEMS 25, 297 (2016).

48. **C.H. Ahn, E.J Ng, V.A Hong, J. Huynh, S. Wang**, and T.W. Kenny, "Characterization of Oxide-Coated Polysilicon Disk Resonator Gyroscope Within a Wafer-Scale Encapsulation Process", JMEMS 24, 1687 (2015).

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50. **Y. Won**, Y. Gao, R. Guzman de Villoria, B.L. Wardle, R. Xiang, S. Maruyama, T.W. Kenny, and K.E. Goodson, "Nonhomogeneous morphology and the elastic modulus of aligned carbon nanotube films", Journal of Micromechanics and Microengineering 25, 115023 (2015).

51. M.T Barako, S. Roy-Panzer, T.S. English, T. Kodama, M. Asheghi, T.W. Kenny, and K.E. Goodson, "Thermal Conduction in Vertically Aligned Copper Nanowire Arrays and Composites", ACS Applied Materials and Interfaces, 34, 19251 (2015).

52. V. Zega, S.H. Nitzan, M. Li, **C.H. Ahn, E. Ng, V. Hong, Y.Yang**, T.W. Kenny, A. Corigliano, and D.A. Horsley, "Predicting the closed-loop stability and oscillation amplitude of nonlinear parametrically amplified oscillators", Appl. Phys. Lett. 106, 233111 (2015).

53. S.H. Nitzan, V. Zega, M. Li, **C.H. Ahn**, A. Corigliano, T.W. Kenny and D.A. Horsley, "Self-Induced Parametric Amplification arising from Nonlinear Elastic Coupling in a Micromechanical Resonating Disk Gyroscope", Scientific Reports 5:9036 (2015)

54. **C.H. Ahn, E.J. Ng, V.A. Hong, Y.Yang, B. Lee, I. Flader** and T.W. Kenny, "Mode-Matching of Wineglass-Mode Disk Resonator Gyroscope in (100) Single Crystal Silicon", JMEMS 24, 343 (2015).

55. **V.A. Hong, S. Yoneoka, M.W. Messana, A.B. Graham, J.C. Salvia, T.T. Branchflower, E.J. Ng** and T.W. Kenny, "Fatigue Experiments on Single-Crystal Silicon in an Oxygen-Free Environment", JMEMS 24, 351 (2015).

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DARPA Program Manager Portfolio (10/1/06 – 9/30/10)

DARPA MIATA Program (MicroAntenna Arrays – Technology and Applications).

- $40M Program Launched by Henryk Temkin in 2005
- Focused on microfabricated antennas for mm-wave radiation sensors, and on integration of antenna, sensor, amplifier and readout circuitry in same structure

DARPA TGP Program (Thermal Ground Plane).

- $50M Program Launched by Thomas Kenny in 2007
- Focused on microfabricated vapor chamber chamber heat spreaders with reduced dimensions, increased performance, and circuit-compatible materials

DARPA YFA Program (Young Faculty Award).

- $7M/year Program Launched by Henryk Temkin in 2006, re-run in 2007 and 2008.
- Provided small ($200K) grants to promising young faculty throughout the US with ideas and interests that could lead to new technologies for the DoD.

DARPA TBN Program (Tip-Based Nanofabrication)

- $50M Program Launched by Thomas Kenny in 2007
- Focused on controlled nanofabrication, with emphasis on controlling the size, shape, location and other properties of every nanostructure formed on a surface.

DARPA MACE Program (Microtechnologies for Air-Cooled Exchangers).

- $35M Program Launched by Thomas Kenny in 2008
- Focused on use of microtechnologies in air-cooled heat exchangers

DARPA NTI Program (NanoThermal Interfaces).

- $30M Program Launched by Thomas Kenny in 2009
- Focused on development of new nanostructured materials for enhanced thermal interfaces for electronics cooling.

DARPA CEE Program (Casimir Effect Enhancement).

- $10M Program Launched by Thomas Kenny in 2010
- Focused on demonstration of reduced adhesion at the nanoscale through the use of the Casimir effect

DARPA ACM Program (Active Cooling Modules).

- $30M Program Launched by Thomas Kenny in 2010)
- Focused on development of complete, high-performance cooling modules based on thermoelectric refrigeration, vapor compression refrigeration, and other novel refrigeration concepts.

DARPA NJTT Program (Near-Junction Thermal Transport).

- $25M Program Formulated by Thomas Kenny in 2010, Launched by Avram Bar-Cohen in 2011
- Program focus is on enhanced thermal conduction in the region immediately beneath the hot spots in high-power electronic devices.

DARPA "Seedlings" ($250K efforts to prove key initial pieces of technology)

- ~20 projects solicited, launched and managed
- Produced important early results for TGP, TBN, NTI and ACM programs.

Patents (>50 Issued US Patents)

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