

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., SAMSUNG ELECTRONICS
AMERICA, INC., FOSSIL GROUP, INC., FOSSIL STORES I, INC., FOSSIL
PARTNERS, L.P., OURA HEALTH OY, AND ONEPLUS TECHNOLOGY
(SHENZHEN) CO., LTD.,

Petitioners,

v.

OMNI MEDSCI, INC.,

Patent Owner.

U.S. Patent No. 12,268,475

Case No. IPR2025-01254

DECLARATION OF IGOR EFIMOV, PH.D.

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I, Igor Efimov, declare as follows:

1. I make this declaration based upon my own personal knowledge and, if called upon to testify, would testify competently to the matters stated herein.

2. I have been retained on behalf of Omni MedSci, Inc., ("Omni" or "Patent Owner") as an independent expert to provide this declaration concerning the technical subject matter relevant to U.S. Patent No. 12,268,475 ("the '475 Patent") (Ex. 1001) in connection with an *inter partes* review ("IPR") petition filed by Samsung Electronics Co. Ltd., Samsung Electronics America Inc., Fossil Group, Inc., Fossil Stores I, Inc., Fossil Partners, L.P., Oura Health Oy, and OnePlus Technology (Shenzhen) Co., Ltd. ("Petitioners").

3. I am being compensated at my standard hourly rate of \$700 per hour for the time I spend on this matter. My compensation is not based on the content of my opinions or the resolution of this matter, and I have no financial or other interest in this proceeding.

4. I understand that Omni is asserting the '475 Patent against Samsung Electronics Co., Ltd., and others, in a related matter currently pending in the United States District Court for the Eastern District of Texas (the "Texas Case").

5. I also understand that Omni is asserting the '475 Patent against Whoop, Inc., in a related matter currently pending in the United States District Court for the District of Delaware ("the Delaware Case").

6. In this declaration, I offer opinions relating to the '475 Patent, claim construction, the references in the Petition, and the declaration of Petitioners' expert Dr. Anthony. The substance and bases of my opinions appear below.

I. BACKGROUND AND QUALIFICATIONS

7. In formulating my opinions, I have relied on my knowledge, training, and experience in the relevant field, which I will summarize briefly herein.

8. I am currently a Professor of Biomedical Engineering and a Professor of Medicine (Division of Cardiology) at Northwestern University, Chicago, Illinois. Prior to my tenure at Northwestern University, I was the Alisann and Terry Collins Professor of Biomedical Engineering at The George Washington University, Washington, D.C., where I also served as Founding Chair of the Department of Biomedical Engineering from 2015 to 2019. Before that, from 2004 to 2015, I served as the Lucy & Stanley Lopata Distinguished Professor of Biomedical Engineering at Washington University in Saint Louis, Missouri. I was also a Professor of Medicine, Professor of Radiology, and Professor of Cell Biology & Physiology at the Washington University School of Medicine. I also served on the faculty of the Department of Cardiology of the Cleveland Clinic Foundation (1994-2000) and the Department of Biomedical Engineering of Case Western Reserve University (2000-2004), Cleveland, Ohio.

9. My research focuses on the physiological mechanisms of cardiovascular disease and the development of diagnostic and therapeutic bioelectronics for heart rhythm disorders, heart failure, and vascular dysfunction. My laboratory develops implantable, wearable, and optical sensing and imaging systems for real-time physiological diagnostics and device-based therapy. These systems incorporate semiconductor light sources, photodiodes, and spectroscopic analysis.

10. I received my Master of Science degree in experimental nuclear physics from the Moscow Institute of Physics and Technology, USSR, in 1986. In 1992, I received a Ph.D. in Biophysics from the Moscow Institute of Physics and Technology after completing a doctoral study on the mechanisms of sudden cardiac death due to ventricular arrhythmias. I completed my postdoctoral training in 1992-1994 in the fields of fast fluorescent imaging / optical mapping, cardiac electrophysiology, and arrhythmia at the University of Pittsburgh in Pittsburgh, Pennsylvania. Then, I started my independent cardiac research career in the Department of Cardiology at the Cleveland Clinic Foundation (1994-2000), where I established an NIH-funded laboratory. Cleveland Clinic has been consistently ranked the #1 Cardiology program nationwide by U.S. News & World Report since 1994.

11. For the past 25 years, I have taught undergraduate and graduate courses in Biomedical Engineering, including courses relating to quantitative physiology, applied bioelectricity, biomedical optics, biosignal acquisition and analysis, light-tissue interaction, physiology of the heart, introduction to biomedical engineering, clinical cardiovascular engineering, and cardiovascular engineering and technology. In these and other courses, I taught sections on engineering and physiological principles of cardiac electrophysiology, arrhythmia, and electrocardiography. Many of my trainees are currently working at leading national medical device companies, including Medtronic, Abbott, and Boston Scientific, developing novel cardiac antiarrhythmic therapies, diagnostics, and sensing devices.

12. I have also mentored over 30 clinical fellows and postdoctoral research fellows, many of whom are currently professors, cardiologists, cardiac and vascular surgeons, and clinical engineers throughout the national and world Universities and hospitals, including Harvard University, MA; University of California, CA; Ohio State University, OH; University of Wisconsin, WI; University of Fukuoka, Japan; University of Bordeaux, France; University of Brno, Czech Republic; Imperial College London, UK; etc.

13. I have published a book in 2009 on cardiac bioelectric diagnostics and therapy (Efimov I.R., Kroll, M.W., Tchou, P.J., Eds., Cardiac Bioelectric Therapy: Mechanisms and Practical Implications, Springer, 2009. ISBN 978-0-387-79402- 0),

and I have published a second updated edition of this book in 2021 (Efimov I.R., Ng F.S., Laughner J.I., Eds., Cardiac Bioelectric Therapy: Mechanisms and Practical Implications, Springer, 2nd Edition. 2021. ISBN 978-3-030-63354-7). These volumes address optical imaging technology and electrophysiological principles of diagnosis and therapy, providing novel approaches to the treatment of cardiac arrhythmias using implantable devices, percutaneous ablation therapies, machine learning, and other approaches.

14. Most of my 300+ peer-reviewed publications focus on cardiac electrophysiology, biomedical optics, device development, the physiological mechanisms of cardiac arrhythmias, and their diagnostics and therapy. In collaboration with Professor John A. Rogers from Northwestern University, we have developed a novel implantable, interventional, and wearable electronics platform for monitoring cardiac electrophysiology, optical image mapping, diagnosis of heart rhythm disorders due to brady- and tachyarrhythmias, and antiarrhythmic therapy. Several high-impact publications have been published on that subject recently in leading scientific journals. For example, our recent paper on novel bioresorbable electronics platform (Choi YS, Yin RT, Pfenniger A, Koo H, Avila R, Lee KB, Chen SW, Lee G, Li G, Qiao Y, Murillo-Berlitz A, Kiss A, Han S, Lee SM, Li C, Xie Z, Chen YY, Burrell A, Geist B, Jeong H, Kim J, Yoon HJ, Banks A, Kang SK, Zhang ZJ, Haney CR, Sahakian AV, Johnson D, Efimova T, Huang Y, Trachiotis GD,

Knight BP, Arora RK, Efimov IR, Rogers JA. Fully implantable and bioresorbable cardiac pacemakers without leads or batteries. *Nature Biotechnology*, June 28, 2021, <https://doi.org/10.1038/s41587-021-00948-x>.) was featured by over 150 international news outlets reaching at least 12 million listeners/viewers from 5 continents, including PBS, Guardian, and NIH Research Matters (NIH Director's office online publication).

15. Another 2025 publication in *Nature* (Zhang Y, Rytkin E, Zeng L, Kim JU, Tang L, Zhang H, Mikhailov A, Zhao K, Wang Y, Ding L, Lu X, Lantsova A, Aprea E, Jiang G, Li SG Seo, Wang T, Wang J, Liu J, Gu J, Liu F, Bailey K, L YFL, Burrell A, Pfenniger A, Ardashev A, Yang T, Liu N, Lyu Z, Purwanto NS, Ying Y, Lu Y, Hoepfner C, Melisova A, Gong J, Jeong J, Choi J, Hou A, Nolander R, Bai W, Jin SH, Ma Z, Torkelson JM, Huang Y, Ouyang W, Arora RK, Efimov IR, Rogers JA. Millimetre-scale, bioresorbable optoelectronic systems for electrotherapy. *Nature*, 2025, 640 (8057), 77-86.) was recognized among the Best Inventions of 2025 by Time magazine.

16. I have also delivered 400+ invited lectures at prestigious professional conferences and leading Universities worldwide, most of them on biomedical imaging, semiconductor-based light emission, optical coupling through tissue, wireless control architectures, cardiac arrhythmias, and therapy. On 2025/11/09 I presented at the annual sessions of the American Heart Association "New sensors

for the future: bringing dreams to reality." Other presentations in 2025 included "Millimeter-scale Bioresorbable Stimulator (milli-pacemaker)", European Section Meeting of the International Academy of Cardiovascular Sciences. Prague, Czechia, 2025/11/04; "Millimeter-scale Bioresorbable Stimulator", RASA Europe conference, Berlin, Germany, 2025/11/1; "Cardiovascular Conformal Bioresorbable Devices", Abbott, 2025/10/21; "Heart-AI interface: Soft Bioresorbable Devices", Cardiology Grand Rounds, University of Rochester Medical Center, Rochester, NY, 2025/09/10; "Heart-AI interface: novel bioelectronic therapy for heart rhythm disorders", Department of Internal Medicine Grand Rounds at the University of Iowa Carver College of Medicine, Iowa City, IA, 2025/09/04; "Bioelectronics for Neurocardiology: Leducq Foundation Update", Lyric, University of Bordeaux, France, 2025/08/27; "Bioresorbable transient electronics", Abbott, 2025/06/16; "Bioresorbable transient electronics", Heart Rhythm Society, San Diego, CA, 2025/04/27; "Bioresorbable milli-pacemaker: transient arrhythmia therapy", Ralph Lazarra Lecture Award, Heart Rhythm Society, San Diego, CA, 2025/04/24; "Selective p38 γ silencing by rationally designed siRNA for mitigating anthracycline cardiotoxicity", Lurie Cancer Center, Feinberg School of Medicine, Northwestern University, Chicago, IL, 2025/04/22; "Transient bioelectronics for cardiovascular tissue engineering and medicine", Department of Biomedical Engineering, University of Alabama at Birmingham, AL, 2025/04/18; "Cardiac bioelectronics for

heart rhythm disorders", Leiden University Medical Center, Leiden, Netherlands,
2025/01/21.

17. In 2021-2025, I served as Editor-in-Chief of Cardiovascular Engineering and Technology, a journal of the Biomedical Engineering Society published by Springer Nature. I was responsible for reviewing and decision-making of approximately 250-300 manuscripts submitted for publication, including biomedical imaging mapping, cardiac electrophysiology, signal processing, arrhythmia therapy, etc.

18. I have served on the editorial board of the American Journal of Physiology: Heart and Circulatory Physiology and Heart Rhythm Journal, where I manage and make decisions on manuscripts related to biomedical sensing and imaging, cardiac electrophysiology and electrotherapy. I have served or currently am serving on many editorial boards of other leading cardiac journals, where I review papers on biomedical imaging technique, cardiac electrophysiology and arrhythmia. These journals include Circulation Research, Heart Rhythm, Journal of Cardiac Electrophysiology, Journal of Molecular and Cellular Cardiology, American Journal of Physiology, IEEE Transactions in Biomedical Engineering, Experimental Physiology, etc. I regularly review papers on biomedical imaging, cardiovascular physiology and arrhythmia for Nature, Science, Proceedings of the National Academy of Science, Circulation, and other leading journals.

19. I have served on numerous national and international expert panels, which consider grant applications from the leading experts in the field of biomedical optics, diagnostic sensing, cardiac electrophysiology, and defibrillation from many countries, including the USA, the European Union, Canada, the UK, France, Switzerland, Germany, the Netherlands, Russia, Australia, New Zealand, South Africa, Singapore, etc. From 2009-2013, I served as a chartered member of the leading US panel at the National Institutes of Health, the Electrical Signaling, Transporters and Arrhythmia (ESTA) Study section, which is the major funding source for leading US bioinstrumentation investigators. I have also served on many international panels that consider policy, research, and funding decisions in the field of biomedical sensing, cardiac electrophysiology and therapy in numerous countries from most continents. For example, I served on The Expert Panel on the Medical and Physiological Impacts of Conducted Energy Weapons, the Council of Canadian Academies.

20. My research on biomedical imaging and electronics has been funded by the National Heart, Lung, and Blood Institute of the National Institutes of Health and other federal and private foundations without interruptions since 1998, with an average of approximately \$1M per year during recent years. I am also funded by the American Heart Association, National Science Foundation, Leducq Foundation, etc.

21. I have been designing and developing medical devices and diagnostic systems for more than twenty-five years. My inventions and patent portfolio include methods for low-voltage cardiac defibrillation, optical and electrical biosensors, cardiac and neural stimulators, and hybrid optoelectronic systems for tissue monitoring and physiological diagnostics. Many of these devices integrate semiconductor light sources, photodetectors, and optical mapping technologies. For example, I am the inventor or co-inventor on several patents and patent applications, including "Systems and Methods for Triple-Parametric Optical Mapping" (U.S. Pat. App. Pub. No. 2023/0085578), "Distributed Neuromorphic Computing for High-Definition Bioelectric Diagnostics and Therapy" (U.S. Patent No. 11,701,002), and "High-Resolution Multi-Function and Conformal Electronics Device for Diagnosis and Treatment of Cardiac Arrhythmias" (PCT/US18/16499). With the support of NIH funding, I have invented a method for low-voltage defibrillation of cardiac arrhythmias by effectively unpinning anatomical reentry (U.S. Patent No. 8,175,702), a method for cardiac pacing using the inferior nodal extension (U.S. Patent No. 8,391,995), and a method and device for low-energy termination of atrial tachyarrhythmias (U.S. Patent No. 8,509,889). I founded Cardialen, Inc. to develop clinical defibrillators based on this method, which received over \$30M in venture and NIH funding. Cardialen was acquired in 2022.

22. I have received many awards in recognition of my research and innovation in the field of bioengineering and diagnostic device development. For example, I was elected to the United States National Academy of Inventors in 2019; and I have received the 2021 Distinguished Scientist Award and the 2025 Ralph Lazzara Lectureship Award from the leading clinical cardiac electrophysiology professional association – the Heart Rhythm Society. In 2025, I was elected to the American Academy of Sciences and Letters.

23. A more detailed listing of my credentials is set forth in my curriculum vitae (Ex. 2044).

II. MATERIALS CONSIDERED

24. In forming the opinions set forth herein, I have considered and relied upon my education, knowledge of the relevant field, and my experience. I have also reviewed and considered the '475 Patent (Ex. 1001) and the '475 Patent's file history (Ex. 1002), and at least the following additional materials.

- Petition for *Inter Partes* Review of the '475 Patent (Paper 1) ("Petition");
- Declaration of Brian Anthony in Support of Petition for *Inter Partes* Review of U.S. Patent No. 11,160,475 (Ex. 1003);

- Previous Declaration of Brian Anthony in Support of Petition for *Inter Partes* Review of U.S. Patent No. 9,651,533 submitted in IPR2019-00916 (Ex. 1004);
- Petition in *Apple Inc. v. Omni Medsci, Inc.*, IPR2019-00916, Paper 1 (PTAB Apr. 10, 2019) (Ex. 1005);
- Patent Owner Response in *Apple Inc. v. Omni Medsci, Inc.*, IPR2019-00916, Paper 23 (PTAB Jan. 31, 2020) (Ex. 1006);
- Institution Decision in *Apple Inc. v. Omni Medsci, Inc.*, IPR2019-00916, Paper 16 (PTAB Oct. 18, 2019) (Ex. 1007);
- Final Written Decision in *Apple Inc. v. Omni Medsci, Inc.*, IPR2019-00916, Paper 39 (PTAB Oct. 14, 2020) ("533-FWD") (Ex. 1008);
- *Omni MedSci, Inc. v. Apple Inc.*, No. 21-01229, ECF 69 (Fed. Cir. June 8, 2022) (Ex. 1009);
- Previous Declaration of Brian Anthony in Support of Petition for *Inter Partes* Review of U.S. Patent No. 10,517,484 submitted in IPR2021-00453 (Ex. 1010);
- Petition in *Apple Inc. v. Omni Medsci, Inc.*, IPR2021-00453, Paper 1 (PTAB Jan. 22, 2021) (Ex. 1011);
- Patent Owner Response in *Apple Inc. v. Omni Medsci, Inc.*, IPR2021-00453, Paper 10 (PTAB Nov. 12, 2021) (Ex. 1012);

- Institution Decision in *Apple Inc. v. Omni Medsci, Inc.*, IPR2021-00453, Paper 7 (PTAB Aug. 6, 2021) (Ex. 1013);
- Petitioner Reply in *Apple Inc. v. Omni Medsci, Inc.*, IPR2021-00453, Paper 11 (PTAB Feb. 4, 2022) (Ex. 1014);
- Final Written Decision in *Apple Inc. v. Omni Medsci, Inc.*, IPR2021-00453, Paper 22 (PTAB Aug. 3, 2022) ("484-FWD") (Ex. 1015);
- Final Written Decision on Remand in *Apple Inc. v. Omni Medsci, Inc.*, IPR2021-00453, Paper 26 (PTAB Feb. 14, 2025) (Ex. 1016);
- *Apple Inc. v. Omni MedSci, Inc.*, No. 23-01034, ECF 44 (Fed. Cir. June 21, 2024) (Ex. 1017);
- *Omni MedSci, Inc. v. Apple Inc.*, 2:18-cv-00134-RWS, Dkt. No. 211 (E.D. Tex. June 24, 2019) (Ex. 1018);
- *Omni MedSci, Inc. v. Apple Inc.*, 2:18-cv-00429-RWS, Dkt. No. 152 (E.D. Tex. Aug. 14, 2019) (Ex. 1019);
- Second Amended Docket Control Order, June 16, 2025. *Omni MedSci, Inc. v. Samsung Electronics Co., Ltd. et al.*, No. 2:24-cv01070-JRG-RSP (E.D. Tex.) (Ex. 1020);
- Plaintiff's Disclosure of Asserted Claims & Infringement Contentions, May 9, 2025. *Omni MedSci, Inc. v. Samsung Electronics Co., Ltd. et al.*, No. 2:25-CV-00483-JRG-RSP (E.D. Tex.) (Ex. 1022)

- Defendants' Supplemental Invalidity and Subject Matter Eligibility Contentions, July 18, 2025. *Omni MedSci, Inc. v. Samsung Electronics Co., Ltd. et al.*, No. 2:24-cv-01070-JRG-RSP (E.D. Tex.) (Ex. 1023);
- U.S. Patent No. 9,241,676 ("Lisogurski") (Ex. 1025);
- U.S. Patent Pub. No. 2010/0217102 ("LeBoeuf") (Ex. 1026);
- U.S. Patent No. 8,108,036 ("Tran") (Ex. 1027);
- U.S. Patent Pub. No. 2005/0049468A1 ("Carlson") (Ex. 1028);
- U.S. Patent No. 8,050,730 ("Zhang") (Ex. 1031);
- U.S. Patent Pub. No. 2011/0237911 ("Lamego") (Ex. 1033);
- U.S. Patent No. 5,942,749 ("Takeuchi") (Ex. 1034);
- U.S. Patent No. 5,822,473 ("Magel") (Ex. 1035);
- U.S. Patent No. 5,592,124 ("Mullins") (Ex. 1036);
- E.F. Schubert, *Light-Emitting Diodes* (Cambridge Univ. Press, 2nd ed. reprinted 2014) (Ex. 1037);
- Joseph D. Bronzino, *The Biomedical Engineering Handbook* (1995) (Ex. 1038);
- U.S. Patent No. 8,079,735 ("Vakil") (Ex. 1039);
- U.S. Patent No. 5,511,553 ("Segalowitz") (Ex. 1044);
- U.S. Patent No. 6,801,799 ("Mendelson") (Ex. 1045);

- U.S. Patent No. 9,239,951 ("Hoffberg") (Ex. 1048);
- U.S. Patent Pub. No. 2007/0194939 ("Alvarez") (Ex. 1049);
- U.S. Patent No. 8,996,088 ("Dasco") (Ex. 1052);
- U.S. Patent Pub. No. 2007/0149868 ("Blank") (Ex. 1053);
- U.S. Patent No. 8,852,103 ("Rothberg") (Ex. 1054);
- U.S. Patent No. 8,922,788 ("Addison") (Ex. 1057);
- JP3552090 ("Denso") (Certified English Translation) (Ex. 1058);
- JP3552090 ("Denso") (Ex. 1059);
- U.S. Patent No. 5,554,273 ("Demmin") (Ex. 1064);
- U.S. Patent No. 5,953,713 ("Behbehani") (Ex. 1065);
- U.S. Patent No. 9,651,533 ("533") (Ex. 1081);
- U.S. Patent No. 10,517,484 ("484") (Ex. 1082);
- Declaration of Brian Anthony in Support of Petition for *Inter Partes Review* of U.S. Patent No. 9,861,286 submitted in IPR2019-00914 (Ex. 1083);
- Declaration of Jonathan Bradford (Ex. 1084);
- 2026-03-23 - Claim Construction Order, *Omni MedSci, Inc. v. Samsung Electronics Co., Ltd. et al.*, No. 2:24-cv-01070-JRG-RSP (E.D. Tex.) (Ex. 1122);

- Deposition of Brian W. Anthony, Volume I, April 17, 2026 (Ex. 2045);
- Deposition of Brian W. Anthony, Volume II, April 18, 2026 (Ex. 2046);
- Declaration of Mohammed N. Islam, Sc.D (Ex. 2100);
- OMS_SAM0031768 (Ex. 2101);
- OMS_SAM0031776 (Ex. 2102);
- OMS_SAM0031782 (Ex. 2103);
- OMS_SAM0031797 (Ex. 2104);
- OMS_SAM0031867 (Ex. 2105);
- OMS_SAM0031851 (Ex. 2106);
- OMS_SAM0031961 (Ex. 2107);
- U.S. Patent No. 5,632,272 to Diab et al. (“Masimo ‘272 Patent”) (Ex. 2108);
- U.S. Patent No. 7,738,935 to Turcott (“Pacesetter ‘935 Patent”) (Ex. 2109);
- U.S. Patent No. 6,126,595 to Amano et al. (Ex. 2110);
- Fitbit ‘854 Publication (Ex. 2111);
- GE Dash 2000 Patient Monitor Operating Manual (Ex. 2112);
- Accuracy in wrist-worn, sensor-based measurements of heart rate and energy expenditure in a diverse cohort (Ex. 2113);

- Are Currently Available Wearable Devices for Activity Tracking and Heart Rate Monitoring Accurate, Precise, and Medically Beneficial? (Ex. 2114);
- A review of wearable sensors and systems with application in rehabilitation (Ex. 2115)
- '475 Patent Infringement Contentions Chart for Samsung Smartwatch (Ex. 2116).

25. I have also considered any materials cited in this declaration to the extent they are not expressly listed above. My review of these materials was informed by my education, my work experience, and my experience designing medical devices.

26. I reserve the right to supplement my opinions or express additional opinions should additional and/or presently unknown information about this matter become known by me at a later date.

III. LEGAL STANDARDS

27. As a technical expert, I am not offering any legal opinions. Rather, I am offering technical assessments and opinions. In rendering my analysis, I have been informed by counsel regarding various legal standards for determining patentability. I have applied those standards in forming my technical opinions expressed in this declaration.

A. Level of Ordinary Skill in the Art

28. I understand that the claims and specification of a patent are addressed to and intended to be read by others of skill in the art to which the patent pertains, or to which the patent is most nearly connected, at the time of the filing of the patent application.

29. I understand that a person of ordinary skill in the art ("POSITA") is a hypothetical person who is presumed to be aware of all of the pertinent art. The person of ordinary skill is not an automaton, and may be able to fit together the teachings of multiple prior art references employing ordinary creativity and the common sense that familiar items may have obvious uses beyond their primary purposes.

30. I understand that multiple factors should be used to decide the skill of the POSITA, including: the types of problems encountered in the art, prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the education level of active workers in the field.

B. Claim Construction

31. The patent claims describe the invention made by the inventor and describe what the patent owner owns and what the owner may prevent others from using. I understand that an independent claim sets forth all the requirements that

must be met to be covered by that claim. I further understand that a dependent claim does not itself recite all of the requirements of the claim but refers to another claim and incorporates all of the requirements of the claim to which it refers.

32. I understand that claim construction is the process by which the scope and meaning of terms used in the claims of a patent is determined. I understand that the goal of this process is to give claim terms the ordinary and customary meaning they would have had to a POSITA at the time of the invention, after reading the patent and its prosecution history.

33. I understand that the patent specification may reveal a special definition given to a claim term by the patentee that differs from the plain and ordinary meaning it would otherwise have to a POSITA. In such cases, I understand that the patentee's definition usually controls.

34. I understand that the prosecution history of a patent can inform the meaning of some claim language and that the prosecution history must be considered when construing the claims.

35. I understand that extrinsic evidence, such as dictionaries, treatises, and expert opinions, may also be considered to understand the technology at issue and the way in which claim terms would be understood by a POSITA in the relevant timeframe.

C. Anticipation

36. I understand that anticipation analysis is a two-step process. The first step is to determine the meaning and scope of the asserted claims. Each claim must be viewed as a whole, and it is improper to ignore any element of the claim. For a claim to be anticipated under U.S. patent law: (1) each and every claim element must be identically disclosed, either explicitly or inherently, in a single prior art reference; (2) the claim elements disclosed in the single prior art reference must be arranged in the same way as in the claim; and (3) the identical invention must be disclosed in the single prior art reference, in as complete detail as set forth in the claim. Where even one element is not disclosed in a reference, the anticipation contention fails. Moreover, to serve as an anticipatory reference, the reference itself must be enabled, i.e., it must provide enough information so that a person of ordinary skill in the art can practice the subject matter of the reference without undue experimentation.

37. I understand that where a prior art reference fails to explicitly disclose a claim element, the prior art reference inherently discloses the claim element only if the prior art reference must necessarily include the undisclosed claim element. Inherency may not be established by probabilities or possibilities. The fact that an element may result from a given set of circumstances is not sufficient to prove inherency.

D. Obviousness

38. I understand that a patent claim is invalid under 35 U.S.C. § 103 only if the differences between the claimed invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in that art. An obviousness analysis requires consideration of four factors: (1) scope and content of the prior art relied upon to challenge patentability; (2) differences between the prior art and the claimed invention; (3) the level of ordinary skill in the art at the time of the invention; and (4) the objective evidence of non-obviousness, such as commercial success, unexpected results, the failure of others to achieve the results of the invention, a long-felt need which the invention fills, copying of the invention by competitors, praise for the invention, skepticism for the invention, or independent development.

39. I understand that a prior art reference is proper to use in an obviousness determination if the prior art reference is analogous art to the claimed invention. I understand that a prior art reference is analogous art if at least one of the following two considerations is met. First, a prior art reference is analogous art if it is from the same field of endeavor as the claimed invention, even if the prior art reference addresses a different problem and/or arrives at a different solution. Second, a prior art reference is analogous art if the prior art reference is reasonably pertinent to the

problem faced by the inventor, even if it is not in the same field of endeavor as the claimed invention.

40. Furthermore, I understand that a claim may be obvious in view of a single prior art reference, without the need to combine references, if the elements of the claim that are not found in the reference can be supplied by the knowledge or common sense of one of ordinary skill in the relevant art.

41. I further understand that a reconstructive hindsight approach to this analysis, i.e., the improper use of post-invention information to help perform the selection and combination, or the improper use of the listing of elements in a claim as a blueprint to identify selected portions of different prior art references in an attempt to show that the claim is obvious, is not permitted. In other words, one should avoid using the challenged patent as a guide through the prior art references, combining the right references in the right way so as to achieve the result of the claims at issue. Instead, one must put oneself in the place of a person of ordinary skill at the time the invention was made and consider only what was known before the invention was made and not consider what was only known after the invention was made.

42. I also understand that when considering the obviousness of a patent claim, one must consider whether a teaching, suggestion, or motivation to combine the references exists so as to avoid impermissibly applying hindsight when

considering the prior art. I understand that a teaching, suggestion, or motivation may be found explicitly or implicitly: (1) in the prior art; (2) in the knowledge of those of ordinary skill in the art; or (3) from the nature of the problem to be solved. I also understand that the motivation to combine references may include logic, judgment, and common sense, but that any such motivation to combine references must still avoid the improper application of hindsight or reliance on the patentee's disclosure of his invention as found in the patent specification, drawings, and claims.

43. I understand that it must also be shown that one having ordinary skill in the art at the time of the invention would have had a reasonable expectation that a modification or combination of one or more prior art references would have succeeded.

44. I understand that obviousness should be considered in light of the problems known to the person having ordinary skill in the art and the complexity of the alternatives for solving the problems. That individual elements of the claimed invention are disclosed in the prior art is not alone sufficient to reach a conclusion of obviousness.

45. While certain combinations of the prior art might be "obvious to try," I understand that any obvious to try analysis will not render a patent invalid unless it is shown that the possible combinations are: (1) sufficiently small in number so as to be reasonable to conclude that the combination would have been selected; and (2)

such that the combination would have been believed to be one that would produce predictable and well understood results.

46. I understand that each alleged prior art reference in a proposed obviousness combination must be evaluated in its entirety, i.e., including those portions that would argue against obviousness, and must be considered for everything that it teaches, not simply the described invention or a preferred embodiment. I understand that it is impermissible to pick and choose from any one reference only so much of it as will support a given position to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one skilled in the art, or to ignore portions of the reference that argue against obviousness. I also understand that all of the supposed prior art to be combined as proposed must also be evaluated as a whole and should be evaluated for what they teach in combination as well as separately.

47. I also understand that if the teachings of a prior art reference would lead one skilled in the art to make a modification that would render that prior art device, system, or method inoperable, then such a modification would generally not be obvious. I also understand that if a proposed modification would render the prior art device, system, or method unsatisfactory for its intended purpose, then there is strong evidence that no suggestion or motivation existed at the time of the subject invention to make the proposed modification.

48. I understand that it is improper to combine references where the references teach away from their combination. I understand that a reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. It is also my understanding that the degree of teaching away will depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant. I understand that a reference teaches away, for example, if (1) the combination would produce a seemingly inoperative device, or (2) the references leave the impression that the product would not have the property sought by the applicant or would no longer achieve the intended purpose(s) of the references being modified or combined.

E. Dependent Claims

49. I understand that a dependent claim incorporates each and every limitation of the claim from which it depends. Thus, my understanding is that if a prior art reference or combination of prior art references fails to render obvious an independent claim, then that prior art reference or combination of prior art references also necessarily fails to render obvious all dependent claims that depend from the independent claim.

IV. LEVEL OF SKILL IN THE ART

50. I understand that the level of ordinary skill in the relevant art at the time of the invention is relevant to inquiries such as the meaning of claim terms, the meaning of disclosures found in the prior art, and the reasons one of ordinary skill in the art may have for combining references.

51. I have reviewed the definition of the level of ordinary skill in the art proposed in the Petition, which is:

on or before the claimed priority date of 12/31/2012, a POSITA would have had a good working knowledge of optical sensing techniques and their applications, and familiarity with optical design and signal processing techniques. Such a person would have obtained such knowledge through an undergraduate education in engineering (electrical, mechanical, biomedical, or optical) or a related field of study, along with relevant experience studying or developing physiological monitoring devices...in industry or academia.

Petition at 16-17 (internal quotations and citations omitted).

52. For purposes of this declaration, I have applied the Petitioners' proposed definition in my analysis. I reserve the right to identify a differing level of skill in the art for the '475 Patent should an IPR be instituted.

53. As of the relevant time period of December 2012, I was at least a person of ordinary skill in the art through my education and experience under the definition Petitioners have proposed. I am also familiar with individuals having this level of skill in the relevant timeframe and am capable of addressing the issues from the perspective of such a person, and I have done so in this declaration.

V. OVERVIEW OF THE '475 PATENT

54. The '475 Patent discloses, for example, a wearable device, and system including a wearable device, for measuring physiological parameters and for use with a smartphone or tablet. Ex. 1001 at Abstract, 8:39-57, 9:29-62, 35:32-37, FIG. 24. The '475 Patent discloses such a wearable that includes a light source comprising a plurality of light emitting diodes that generate an output light that is delivered to tissue. Ex. 1001 at Abstract, 8:39-57, 9:29-62. The '475 Patent also discloses that the wearable device includes a detection system comprising a plurality of detectors, and the detection system receives at least a portion of reflected light and generates an output signal. Ex. 1001 at Abstract, 8:39-61, 9:29-62.

55. An exemplary physiological measurement system is depicted in Figure 24:

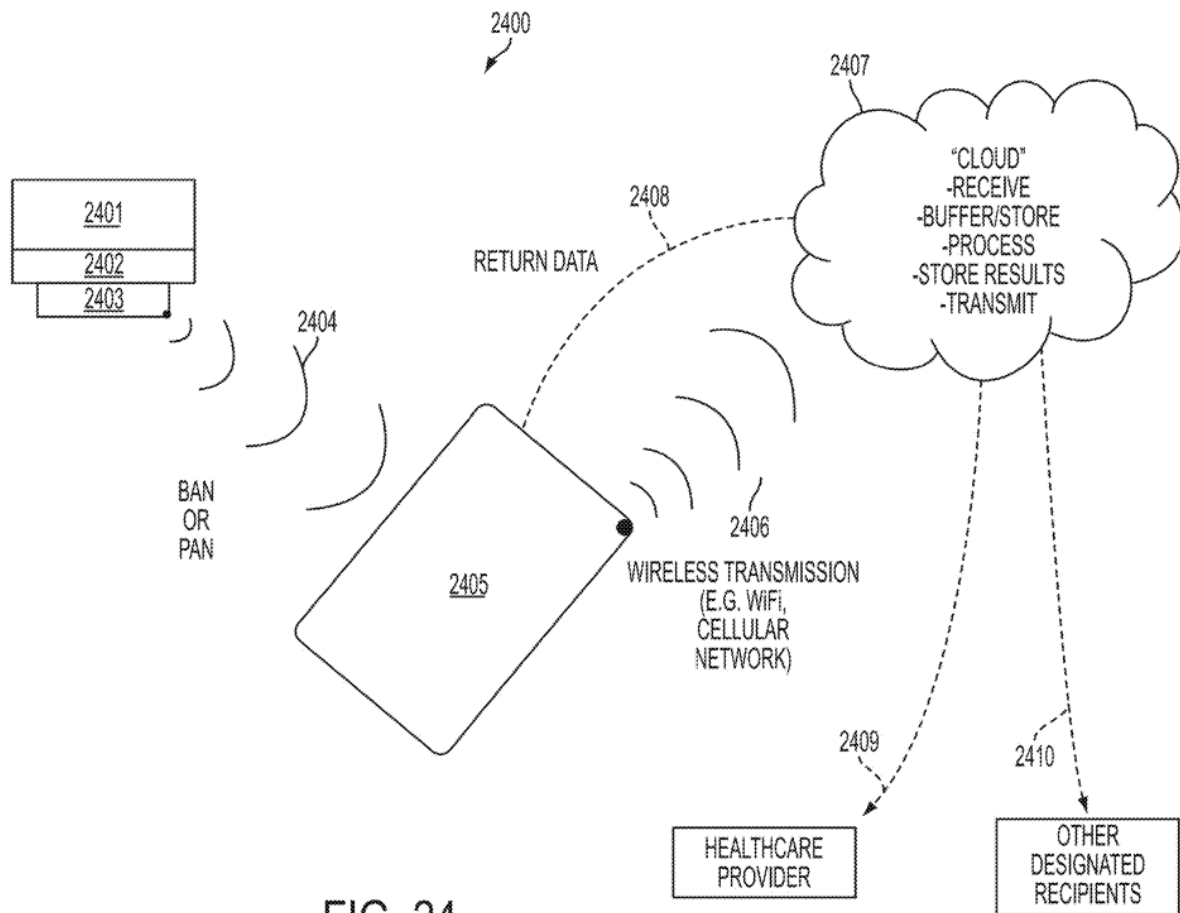


FIG. 24

Ex. 1001 at FIG. 24, 11:32-37. The exemplary system depicted in Figure 24 includes a measurement device 2401, a personal device 2405 such as a smartphone or tablet, and a cloud server 2407. Ex. 1001 at 35:32-36:3.

56. The '475 Patent discloses that the wearable device may comprise one or more biosensors. Ex. 1001 at Abstract. The '475 Patent also discloses that the wearable device, or a processor, may be configured to determine, based at least in part on an output signal, that the wearable device is being worn by a user. Ex. 1001 at Abstract, 9:3-62. The '475 Patent also discloses that the wearable device may

comprise a processor configured to be coupled to a non-transitory computer readable medium. Ex. 1001 at 86:1-3. The '475 Patent also discloses that the plurality of detectors may be arranged along an arc. Ex. 1001 at 86:9-10.

57. Additionally, the '475 Patent discloses multiple techniques employed by the wearable measurement device that improve the signal-to-noise ratio of the signal. Ex. 1001 at 58:1-22. This results in a more accurate reading of the user's physiological parameters despite interference from spectral artifacts. Ex. 1001 at 3:11-51.

58. The '475 Patent includes 20 claims, and claims 1, 8, and 15 are independent claims. Ex. 1001 at 85:10-88:38.

VI. PROSECUTION HISTORY OF THE '475 PATENT

59. I have reviewed and analyzed the prosecution history of the '475 Patent. I understand that the '475 Patent issued from U.S. Patent Application No. 18/927,698, which was filed on October 25, 2024.

60. I understand that U.S. Patent Application No. 18/927,698 was a continuation of U.S. Patent Application No. 18/899,012, which was filed on September 27, 2024.

61. I understand that the '475 Patent claims priority to Provisional Application No. 61/747,477, which was filed on Dec. 31, 2012 and drafted at least as early as Dec. 24, 2012, Provisional Application No. 61/754,698, which was filed

on Jan. 21, 2013 and drafted at least as early as Aug. 10, 2012, Provisional Application No. 61/747,472, which was filed on Dec. 31, 2012 and drafted at least as early as Aug. 3, 2012, Provisional Application No. 61/747,553, which was filed on Dec. 31, 2012 and drafted at least as early as Dec. 21, 2012, Provisional Application No. 61/747,485, which was filed on Dec. 31, 2012 and drafted at least as early as Sept. 30, 2012, and Provisional Application No. 61/747,487, which was filed on Dec. 31, 2012 and drafted at least as early as Oct. 10, 2012

VII. CHALLENGED CLAIMS

62. I understand that the Petition challenges claims 1, 5-8, 11-13 ("the challenged claims") of the '475 Patent. Petition at 8. Of those challenged claims, I understand that claims 1 and 8 are independent claims. Ex. 1001 at 85:10-86:62. I further understand that dependent claims 5-7 depend (directly or indirectly) from independent claim 1 and that dependent claims 11-13 depend (directly) from independent claim 8. Ex. 1001 at 85:10-86:62.

63. Certain of the challenged claims are reproduced below. Here and throughout the rest of my declaration, for clarity, I separate and identify the claim limitations of the challenged claims using the same separation and alphanumeric identifiers used by the Petition. *See* Petition at viii-xi ("List of Challenged Claims").

64. Independent claim 1 recites the following:

[1.pre] – An apparatus adapted to be worn by a user comprising:

- [1.a] – one or more biosensors adapted to be placed on the user,
- [1.b] – wherein one or more physiological parameters are measured,
- [1.c] – wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;
- [1.d] – a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;
- [1.e] – one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;
- [1.f] – a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,
- [1.g] – wherein the detection system is configured to be synchronized to the light source,
- [1.h] – wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;
- [1.i] – wherein the output signal is indicative of the one or more physiological parameters;
- [1.j] – the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity; and
- [1.k] – the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,
 - [1.l] – generate a second signal responsive to light received while at least one of the light emitting diodes is on, and
 - [1.m] – increase the signal-to-noise ratio by comparing the first signal and the second signal; and
- [1.n] – wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.

65. Dependent claim 5 depends from independent claim 1 and recites the following:

- [5] – The apparatus of claim 1, wherein the apparatus further comprises a

processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.

66. Dependent claim 6 depends from independent claim 1 and recites the following:

[6] – The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.

67. Independent claim 8 recites the following:

[8.pre] – A wearable device configured to be worn by a user, the wearable device comprising:

[8.a] – a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;

[8.b] – a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;

[8.c] – a detector; and

[8.d] – a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and

[8.e] – (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;

[8.f] – (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and

[8.g] – (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.

VIII. CLAIM CONSTRUCTION

68. Petitioners and Dr. Anthony note for certain patents related to the '475 Patent, certain terms that are "identical to or substantially similar to" language in the challenged claims of the '475 Patent were construed in prior Board or district court proceedings. Petitioners and Dr. Anthony otherwise contend that the remaining terms in the challenged claims of the '475 Patent do not require construction and can be afforded their plain and ordinary meaning. Petition at 17-19; Ex. 1003 at ¶¶ 55-67.

69. I understand that the district court has issued a claim construction order for the '475 Patent in the pending Texas Case. Ex. 2033; Ex. 2034; Ex. 1122.

70. I reserve the right to update my opinions should the Board or a district court issue relevant claim constructions for terms within, or substantially similar to, the challenged claims of the '475 Patent (or any other term or phrase in the '475 Patent).

A. Prior Constructions of the Board

71. I understand that in a prior IPR involving U.S. Patent No. 9,861,286, which is related to the '475 Patent, the Board construed the term "modulating at least one of the LEDs" to mean "varying the amplitude, frequency, or phase of the light produced by at least one of the LEDs to include information." Ex. 2037 at 10.

72. For purposes of this declaration, I have been asked to apply the Board's construction for "modulate" / "modulation" in claim 13 of the '475 Patent in my analysis of the grounds in the Petition.

B. Petitioners' Constructions in the Texas Case

73. I understand that in the Texas Case, the district court construed the term "modulate" / "modulation" in claim 13 of the '475 Patent as "[vary/varying/the varying of] the amplitude, frequency, or phase of the light produced." Ex. 1122 at 18. For purposes of this declaration, I have been asked to apply this construction for this term in my analysis.

74. I understand that in the Texas Case, the district court construed the term "modulation frequency" in claim 13 of the '475 Patent as "pulse repetition rate." Ex. 1122 at 18. For purposes of this declaration, I have been asked to apply this construction for this term in my analysis.

75. My opinions regarding Grounds 1-8 as set forth in this declaration would not change regardless of which of the competing constructions noted above is adopted. I reserve the right to update my opinions should the district court or the Board issue claim constructions for these terms/phrases (or any other term or phrase in the '475 Patent).

IX. OVERVIEW OF ASSERTED GROUNDS AND REFERENCES IN THE PETITION

A. Petitioners' Obviousness Grounds

76. I understand that Petitioners have challenged claims 1, 5-8, 11-13 of the '475 Patent as allegedly obvious under 35 U.S.C. § 103 based on eight (8) separate Grounds, as follows (Petition at 8):

Ground	Claims	Asserted Reference(s)			
1	1, 6-8, 11-13	Lisogurski			
2	5, 7	Lisogurski	Tran		
3	6-7	Lisogurski		LeBoeuf	
4	6-7	Lisogurski	Tran	LeBoeuf	
5	1, 6-8, 11-13	Lisogurski			Carlson
6	5, 7	Lisogurski	Tran		Carlson
7	6-7	Lisogurski		LeBoeuf	Carlson
8	6-7	Lisogurski	Tran	LeBoeuf	Carlson

B. Summary of Asserted References

77. I understand that Grounds 1-8 assert various combinations of the following references: "Lisogurski" (Ex. 1025), "Tran" (Ex. 1027), "LeBoeuf" (Ex. 1026), and "Carlson" (Ex. 1028). Petition at 7-8. I understand that Petitioners' Grounds rely on Lisogurski alone or in various combinations with Train, LeBoeuf, and/or Carlson. Petition at 8. Herein, I refer to these alleged prior art references

individually or in various combinations (depending on context) as the "the asserted reference[s]." Below are brief summaries of the asserted references.

1. Lisogurski (Ex. 1025) (Grounds 1-8)

78. U.S. Patent No. 9,241,676 ("Lisogurski") describes a non-invasive physiological monitoring system using pulse oximetry to measure blood oxygen saturation and related parameters. Ex. 1025 at 3:61-4:5. The system is illustrated in Figures 3 and 1:

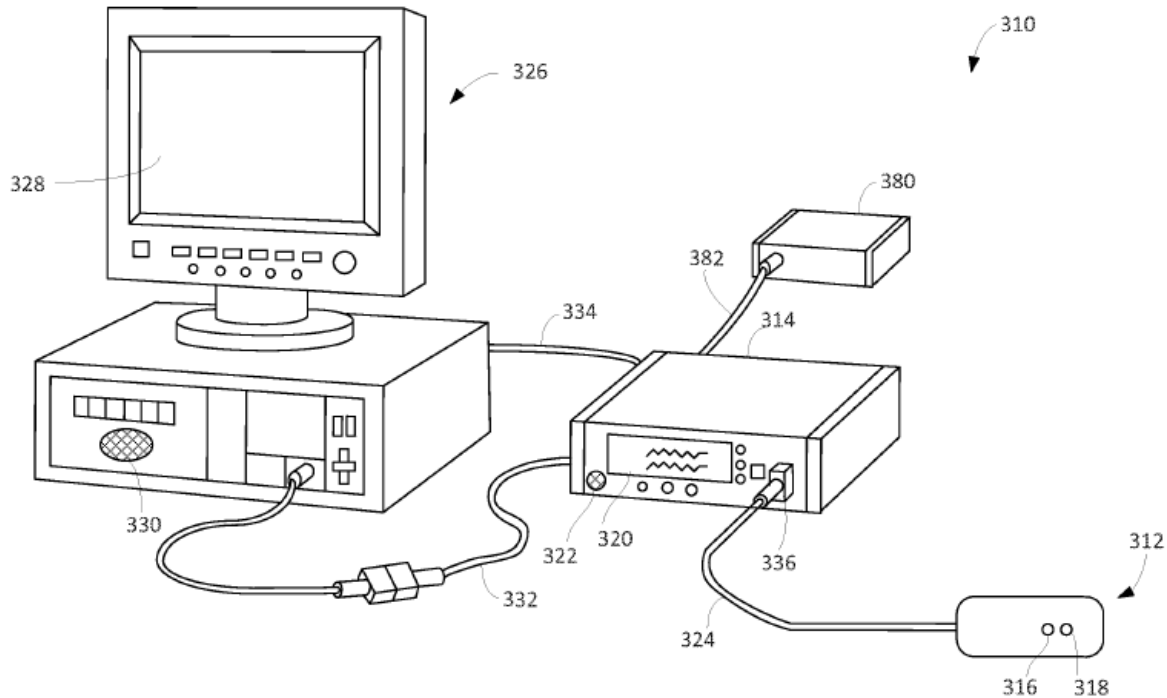


FIG. 3

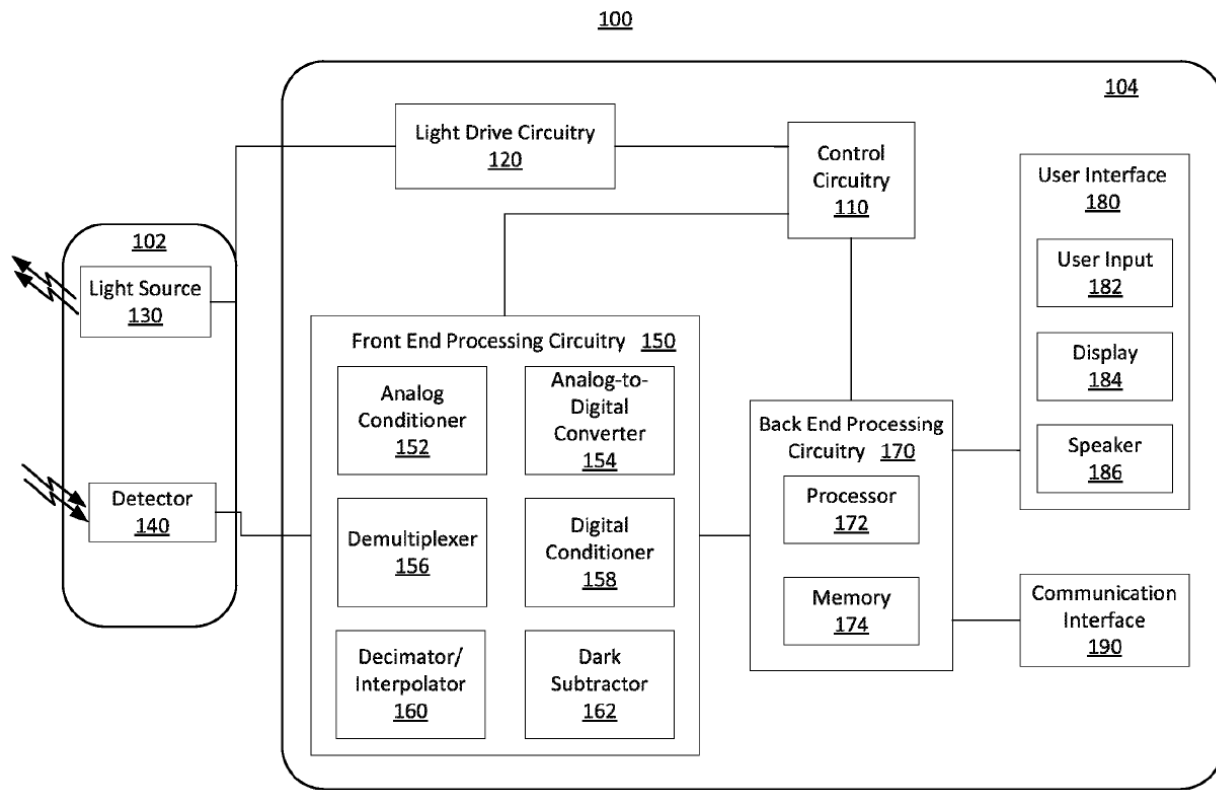


FIG. 1

Ex. 1025 at FIGS. 3, 1. The wearable portion is sensor unit 312, while the other components of the system, such as monitors 314, 326, and calibration device 380, are configured to perform data calculations, display information, and calibrate the system, respectively. Ex. 1025 at 17:54-18:15, 18:32-67. The system uses semiconductor emitters at different wavelengths to illuminate tissue, and a photodetector receives light and converts it into an electrical signal. Ex. 1025 at 4:42-62; 10:48-64. Front end processing circuitry 150 processes the electronic signal. Ex. 1025 at 12:42-49. Then, "[p]rocessor 172 may receive and process physiological signals received from front end processing circuitry 150. For

example, processor 172 may determine one or more physiological parameters based on the received physiological signals." Ex. 1025 at 14:60-64. Based on known differences in wavelength absorption of oxyhemoglobin or deoxyhemoglobin, the system compares the intensities at the different wavelengths to estimate blood oxygen saturation. Ex. 1025 at 24:58-25:5.

2. Tran (Ex. 1027) (Grounds 2, 4, 6, 8)

79. U.S. Patent No. 8,108,036 ("Tran") describes a patient heart monitoring system that includes wireless nodes forming a wireless mesh network. Ex. 1027 at Abstract, 3:3-13, 8:29-33. The system also includes a wearable appliance adapted to communicate with the wireless nodes and a statistical analyzer to determine the occurrence of a heart attack or stroke attack. Ex. 1027 at Abstract, 3:3-13. The wearable appliance may include sensors and non-invasively measure, for example, blood pressure. Ex. 1027 at 4:62-65, 9:23-30.

3. LeBoeuf (Ex. 1026) (Grounds 3-4, 7-8)

80. U.S. Patent Application Publication No. US 2010/0217102 A1 ("LeBoeuf") describes monitoring devices and particularly light-guiding earbuds to be positioned within an ear. Ex. 1026 at Abstract, [0002], [0006], [0009], [0084]. For example, one such light-guiding earbud embodiment is shown in Figure 3:

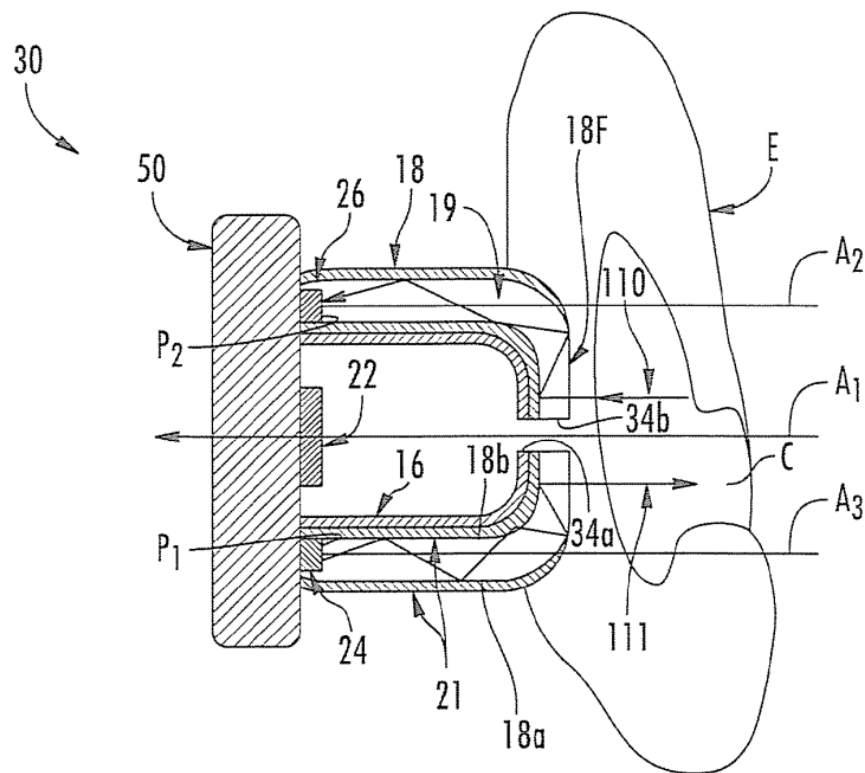


FIG. 3

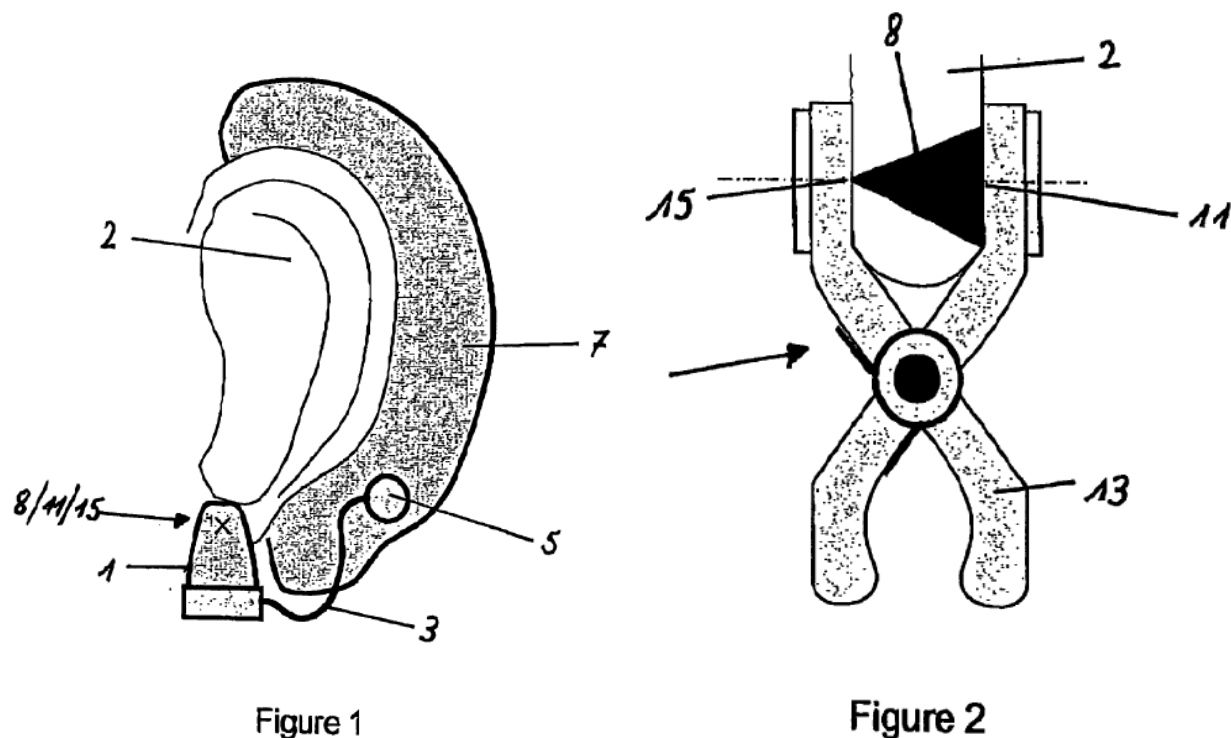
Ex. 1026 at FIG. 3, [0042]. The earbuds include a speaker, such as speaker 22 shown in Figure 3, along with an earbud housing 16 in acoustical communication with the speaker 22 and apertures 34a-34b through which sound from the speaker 22 can pass. Ex. 1026 at [0006], [0009], [0102], FIG. 3. The earbuds also include a light-guiding cover to deliver light from an optical emitter into the ear canal and to deliver collected light to an optical detector, such as shown by cover 18, optical emitter 24, and optical detector 26 depicted in Figure 3. Ex. 1026 at Abstract, [0006], [0106], FIG. 3. The light directed into the ear from a light emitter and the subsequent collection of light at a detector may be used for detecting or measuring,

for example, body or skin temperature, blood gas levels, heart rate, blood flow, etc.

Ex. 1026 at [0010].

4. Carlson (Ex. 1028) (Grounds 5-8)

81. U.S. Patent Application Publication No. 2005/0049468 A1 ("Carlson") describes an optical pulse oximeter for non-invasive measurement of pulsation and blood oxygen saturation. Ex. 1028 at [0002]. Carlson describes an ear-clip form factor. Ex. 1028 at [0048]-[0049]. That form factor is illustrated in Figures 1 and 2:



Ex. 1028 at FIGS. 1-2. Carlson describes optical and/or electronic means to improve signal-to-noise and signal-to-background performance by using beam shaping optical elements, such as diffractive or refractive lenses, to direct light into

tissue and a photon detecting element. Ex. 1028 at [0010], [0013]-[0014]. Carlson also discloses the use of "optical wavelength filters" for filtering light to a particular range of wavelengths before it reaches a photo detecting element. Ex. 1028 at [0026], [0062]. Finally, Carlson describes module packaging arrangements integrating these optical elements. Ex. 1028 at [0041], [0062], FIG. 6c.

X. OPINIONS ON GROUNDS IN THE PETITION

82. I understand that Petitioner has asserted obviousness in Grounds 1-8, as summarized above in Section IX, which collectively challenge claims 1, 5-8, 11-13 of the '475 Patent, described above in Section VII. Petition at 8. It is my opinion that none of the challenged claims are obvious over the asserted prior art as set forth in Grounds 1-8.

A. Ground 1: Obviousness Based on Lisogurski (Claims 1, 6-8, and 11-13)

83. I understand that Petitioners and Dr. Anthony argue for Ground 1 that claims 1, 6-8, and 11-13 of the '475 Patent are obvious over Lisogurski alone. Petition at 8, 21-59; Ex. 1003 at ¶¶ 70, 74-269. I disagree for at least the reasons provided below.

1. Independent Claim 1

84. I disagree with Petitioners and Dr. Anthony's assertion that claim 1 is obvious over Lisogurski.

85. Claim 1 of the '475 Patent includes limitation [1.n], which recites "wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user." Ex. 1001 at 85:48-50. A POSITA would understand that limitation [1.n] requires:

- (A) The claimed "determin[ation] ... that the apparatus is being worn by the user" must be made by the "apparatus"; and
- (B) This "determin[ation] ... that the apparatus is being worn by the user" must be "based at least in part on the output signal."

86. Based on my review, Petitioners and Dr. Anthony argue that limitation [1.n]'s claimed "determin[ation] ... that the apparatus is being worn by the user" (which I may refer to herein as the claimed "determin[ation]") is taught by Lisogurski's disclosure of "detect[ing]" a "system error" in the form of a "physiological impossible value" or "probe-off signal." Petition at 42-44 (citing Ex. 1025 at 36:66-7:2; Ex. 1003 at ¶¶ 196-98 (same).

87. Specifically, they rely upon the following disclosure in Lisogurski for the claimed "determin[ation]" in limitation [1.n]:

In some embodiments, the system may detect a signal indicative of a system error such as a physiologically impossible value[] [or] a probe-off signal

Ex. 1025 at 36:66-7:2; *see* Petition at 42-44; Ex. 1003 at ¶¶ 196-98. I may refer herein to this disclosure as Lisogurski's "error detection."

88. For the claimed "apparatus" recited in limitation [1.n], Petitioners and Dr. Anthony rely on Lisogurski's sensor 102/312. Petition at 29, 42-43; Ex. 1003 at ¶¶ 109-12, 196-98.

89. For the claimed "output signal" recited in limitation [1.n], Petitioners and Dr. Anthony rely on Lisogurski's "processed signals" that are sent from front end processing circuitry 150 to back end processing circuitry 170. Petition at 35-36, 42-44; Ex. 1003 at ¶¶ 145-52, 196-98.

90. Regarding the two requirements (A) and (B) of limitation [1.n] that I note above, Petitioners and Dr. Anthony assert or suggest that Lisogurski's error detection (alleged "determin[ation]") is performed by Lisogurski's sensor (alleged "apparatus") using Lisogurski's processed signals (alleged "output signal"). Petition at 42-44; Ex. 1003 at ¶¶ 196-98.

91. Even assuming that Lisogurski's error detection constitutes the claimed "determin[ation] ... that the apparatus is being worn by the user" as alleged, Lisogurski does not disclose or render obvious that the error detection is either made by Lisogurski's sensor (alleged "apparatus") or based at least in part on Lisogurski's processed signals (alleged "output signal") according to limitation [1.n].

a) Previous IPRs Regarding Related Patents

92. I understand that certain portions of the Petition and Dr. Anthony's declaration rely on findings by the Board in prior IPR proceedings challenging

patents related to the '475 Patent, including: (1) the Board's Final Written Decision in IPR2019-00916 (Ex. 1008 at "'533-FWD") regarding U.S. Patent No. 9,651,533 (Ex., 1081, "'533 Patent") and (2) the Board's Final Written Decision in IPR2021-00453 (Ex. 1016 at "'484-FWD") regarding U.S. Patent No. 10,517,484 (Ex. 1082, "'484 Patent"). Petition at 19-21; Ex. 1003 at ¶¶ 133-34.

93. However, limitation [1.n] of the '475 Patent is not recited in the claims of either the '533 Patent or '484 Patent, and Petitioners and Dr. Anthony do not rely on the '533-FWD or '484-FWD in their analysis of limitation [1.n]. *See* Petition at 42-44; Ex. 1003 at ¶¶ 196-98; Ex. 1081; Ex. 1082. Therefore, I understand that to the extent that Petitioners and Dr. Anthony rely on the Board's findings in the '533-FWD and '484-FWD, those prior findings do not address the limitation [1.n] of the '475 Patent.

b) Lisogurski's "Probe-Off" System Error Is Different from Determining the Apparatus "Is Being Worn by the User"

94. Limitation [1.n] recites: "wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user." Ex. 1001 at 85:48-50. Dr. Anthony relies on Lisogurski's "probe-off" error detection as meeting this limitation. Ex. 1003 at ¶¶ 196-198.

95. In my opinion, Lisogurski's "probe-off" error detection is fundamentally different from the claimed "determine ... that the apparatus is being worn by the user."

96. Lisogurski discloses that "the system may detect a signal indicative of a system error such as a physiologically impossible value, a probe-off signal, any other suitable signal, or any combination thereof." Ex. 1025 at 36:66-37:2. As I explained above (see, e.g., ¶ 149), Lisogurski's error detection is mentioned only in this sentence, with no discussion of which component performs the error detection or how it is performed.

97. Lisogurski does not explain the meaning of "probe-off." Lisogurski does explain what "off" means:

As used herein, the terms "on" and "off" are merely exemplary and may not necessarily refer to a fully on or off state. For example, "on" and "off" may refer to switching power or other components, high and low brightness output states, high and low values within a continuous modulation, high and low values of electrical current provided to an emitter, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitter is switched on), any other suitable relatively distinct states, or any combination thereof. In some embodiments, "on" and "off" states may relate to high and low values of a variable that varies with multiple discrete steps. For example, an emitter brightness may be provided by the system as off, low, medium, and high. In this example, an "off" state may refer to off or low emission and "on" may refer to medium or high. In another example, "off" may refer to an off state and "on" may refer to a low, medium, or high output depending on a second input or system variable.

Ex. 2025 at 8:27-44. But those definitions do not address whether the apparatus is

being worn by the user. Ex. 2025 at 8:27-44.

98. A POSITA would have understood that Lisogurski's "probe-off signal" detects a "system error"—a hardware or system-level failure condition indicating that the probe is not on. Ex. 1025 at 36:66-37:2. This is categorically different from affirmatively determining that the apparatus "is being worn by the user" as required by limitation [1.n]. Ex. 1001 at 85:48-50.

99. The distinction is significant. A "system error" such as a "probe-off signal" detects a negative condition—the probe is not on. But limitation [1.n] requires an affirmative determination—that the apparatus is being worn by the user. These are not logical inverses. The absence of a "probe-off" error does not necessarily mean the apparatus is being worn by the user. For example, a probe-off error may not be triggered when: (a) the probe is attached to something other than the user (e.g., a pencil, a table or a piece of fabric); (b) the system has not yet detected an error due to a lag in detection; or (c) the sensor is malfunctioning in a way that suppresses the error signal. In none of these scenarios would the apparatus be "being worn by the user," yet no "probe-off" error would be detected.

100. Dr. Anthony agreed that system errors—such as a probe-off or a physiologically impossible value—reflect a situation in which the signal to be detected is absent, which can arise from multiple conditions, including when the device is not on when the device is being worn but not being worn correctly:

Q. I think I understand. So in pulse oximetry, you're measuring the absorption of hemoglobin in the blood to be able to estimate the oxygen saturation. Is that right?

...

THE WITNESS: Well, your -- your measurement is the detection that there's a signal that there's -- the constituent's there. For example, as -- as also described in Lisogurski, you detect that -- for example, *if in the situation where the device is not on, you detect that it's not on by the fact that you're not detecting the hemoglobin and the signal that you're looking for*, so it's -- you have to detect to measure.

...

Q. So you mentioned a situation when a device is not on. Is that called a probe-off signal in Lisogurski?

A. So, for example, Lisogurski, Line 36, at the bottom -- or Column 36, starting at Line 66 (as read):

"In some embodiments, the system may detect a signal indicative of a system error, such as a physiological impossible value, a probe-off signal" --

So a physiological impossible value, meaning detected that it's not there. So I'm detecting the abs- -- I'm *detecting the absence of the signal to indicate that the probe is off*. Conversely, to detect that the signal is there to measure the hemoglobin.

Ex. 2045 at 44:19-45:20 (emphases added, internal objections omitted).

Q. Well, a POSITA would understand that you could have a physically [sic] impossible value even if the probe is actually being worn. Correct?

...

THE WITNESS: Well, what's described here is that the physiological -- and *physiological impossible signal can be used as one way in -- by itself or in combination with other signals to indicate a system error, including the device not being worn correctly.*

Q. So there would be system errors other than the device not being worn correctly. Is that correct?

A. Well, as I've just described, there are *multiple ways where a system error could occur, and certainly probe-off is one of those, and a non-physiological value detecting the presence of hemoglobin would be one such way to indicate that the hemoglobin is not there* and whether it be probe-off or *light off*, but you're detecting the hemoglobin in that use of the physiologically impossible or not detecting it in the case of the physiological impossible value.

Q. So the answer is yes, there are system errors other than a probe-off. Correct?

THE WITNESS: As I said, indeed, *other errors could occur*, but certainly a POSITA reading Lisogurski would understand that the hemoglobin is being detected and if it's not being detected, that is an indication that probe is off or something other -- *something else could be happening.*

Ex. 2045 at 48:16-49:21 (emphases added, internal objections omitted). Dr.

Anthony's statement is consistent with my opinion that "system errors" including the "probe-off signal" or "a physiologically impossible value" do not necessarily indicate that the wearable device is not being worn by a user. Likewise, the absence of a "probe-off signal" or a "physiologically impossible value" does not necessarily indicate that the wearable device is being worn by a user.

101. Moreover, Lisogurski describes the "probe-off signal" as one of several types of "system error"—alongside "a physiologically impossible value" and "other system error." Ex. 1025 at 36:66-37:2. A POSITA would have understood "system errors" including the "probe-off signal" or "a physiologically impossible value" to be anomalous conditions that indicate the system is not functioning properly, such as a circuit malfunction, sensor failure, an error caused by user sweating, or a software bug – not an affirmative determination of whether the device is worn by a user. The concept of a "system error" presumes the system is operating and encountering a problem; it does not include the affirmative sensing function of determining that the device is being worn.

102. The '475 Patent's specification supports this distinction. The '475 Patent discloses that the wearable device may be "configured to determine ... that the wearable device is being worn by a user." Ex. 1001 at Abstract, 9:3-5. This is an affirmative sensing function—the device actively determines it is being worn—not merely the detection of a system error. A POSITA would have understood that a system designed to affirmatively determine whether the apparatus is being worn would require more sophisticated sensing than merely detecting when the probe is not on.

c) Lisogurski does not disclose or render obvious that the sensor (alleged "apparatus") is configured to make the error detection (alleged "determin[ation]")

103. In my opinion, the recited requirement (A) that the claimed "determin[ation] ... that the apparatus is being worn by the user" must be made by the "apparatus" is not met. Lisogurski does not disclose or render obvious that its sensor, which is alleged to be the claimed "apparatus," is configured to perform Lisogurski's error detection, which is alleged to be the claimed "determin[ation] ... that the apparatus is being worn by the user." That is, Lisogurski does not meet limitation [1.n]'s requirement that "the apparatus is at least in part configured to determine ... that the apparatus is being worn by the user."

104. Lisogurski does not disclose that error detection is performed by its sensor. The concept of "error detection" is only discussed in Lisogurski in a single sentence at 36:66-37:2, which contains Lisogurski's only mention of "error," "physiologically impossible value," and "probe-off signal." Ex. 1025 at 36:66-37:2. This sentence contains no discussion of Lisogurski's sensor or any indication as to what component makes the error detection. Ex. 1025 at 36:54-37:5. Lisogurski merely states that "*the system* may detect a signal indicative of a system error." Ex. 1025 at 36:66-37:2 (emphasis added). A POSITA would not have understood Lisogurski to teach that its sensor is configured to perform error detection.

105. Additionally, Petitioners and Dr. Anthony have not provided an explanation, or supporting evidence, for why a POSITA would have understood or found obvious that Lisogurski's sensor makes the error detection. Petition at 42-44; Ex. 1003 at ¶¶ 196-98.

106. The only evidence that Petitioners and Dr. Anthony cite from Lisogurski to assert that the error detection is performed by its sensor, other than Lisogurski's disclosure of the error detection (i.e., 36:66-37:2, which does not mention Lisogurski's sensor), is Lisogurski's disclosure at 15:66-16:4. Petition at 42-44 (citing Ex. 1025 only at 36:66-37:2, 15:66-16:4); Ex. 1003 at ¶¶ 196-98 (same). That cited portion of Lisogurski states:

It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component.

Ex. 1025 at 15:66-16:4.

107. This cited disclosure from Lisogurski (Ex. 1025 at 15:66-16:4) does not teach or suggest to a POSITA that Lisogurski's sensor performs the error detection, for several reasons. The cited disclosure at 15:66-16:4 contains no mention of either Lisogurski's sensor or error detection. Ex. 1025 at 15:66-16:4. Petitioners and Dr. Anthony provide no explanation as to how this cited disclosure applies to either Lisogurski's sensor or error detection. Petition at 42-44; Ex. 1003 at ¶¶ 196-98.

108. Lisogurski's description at 15:66-16:4 relates to Lisogurski's system 100 that is illustrated in Figure 1, and Lisogurski does not disclose which, if any, component in system 100 performs the error detection. Ex. 1025 at 15:66-16:4, 36:66-37:2. Also, because Lisogurski does not indicate any component in system 100 that performs the error detection, Petitioners and Dr. Anthony do not and cannot explain how such an unidentified component qualifies, along with Lisogurski's sensor, for the cited disclosure's teaching that "the functionality of some of the components may be combined in a single component." Ex. 1025 at 15:66-16:4; Petition at 42-44; Ex. 1003 at ¶¶ 196-98.

109. As I explain in further detail below, a POSITA would have understood that Lisogurski's error detection would have been performed by back end processing circuitry 170 in system 100. A POSITA would not have understood the cited disclosure (Ex. 1025 at 15:66-16:4) to mean that the functionality of the back end processing circuitry 170 may be combined with sensor 102. Ex. 1025 at FIG. 1, 10:42-64, 11:28-32, 2:42-45, 14:56-15:18. In fact, Petitioners and Dr. Anthony do not propose combining Lisogurski's back end processing circuitry 170 and sensor 102. Petition at 26-28, 42-44; Ex. 1003 at ¶¶ 90-107, 196-98.

110. I understand that Petitioners and Dr. Anthony's analysis of limitation [1.n] also includes a citation to JP3552090 ("Denso") (Certified English Translation) (Ex. 1058). Petition at 42-44 (citing Ex. 1058); Ex. 1003 at ¶¶ 196-98 (same). There

is no connection between Lisogurski and Denso such that Denso would affect a POSITA's understanding of Lisogurski's error detection. A POSITA would not understand or find obvious based on unrelated Denso that Lisogurski's error detection is performed by Lisogurski's sensor.

111. Additionally, a POSITA would have understood that Lisogurski's error detection is performed by Lisogurski's back end processing circuitry 170, not sensor 102. Ex. 1025 at FIG. 1, 10:42-64, 11:28-32, 12:42-45, 14:56-15:18. I understand that Petitioners and Dr. Anthony argue that Lisogurski would have been modified to relocate front end processing circuitry 150 from monitor 104 into sensor 102. Petition at 26-28; Ex. 1003 at ¶¶ 90-107. A POSITA would not have understood or found obvious that Lisogurski's error detection is performed by front end processing circuitry 150. Lisogurski teaches that front end processing circuitry 150 contains subcomponents that perform prescribed functions, including analog conditioner 152, analog-to-digital converter 154, demultiplexer 156, digital conditioner 158, decimator/interpolator 160, and dark subtractor 162. Ex. 1025 at FIG. 1, 13:7-14:10. A POSITA would have understood that none of these specified subcomponents of front end processing circuitry 150 performs the error detection. Ex. 1025 at FIG. 1, 13:7-14:10.

112. A POSITA would have understood that front end processing circuitry 150 is intended for signal conditioning, to condition the signal from detector 140 and

send a processed signal to back end processing circuitry 170 for back end processing circuitry 170 to perform tasks such as decision-making and detection. Ex. 1025 at FIG. 1, 12:42-51, 13:7-14:10, 14:56-15:18. This signal conditioning performed by the front end processing circuitry is different from, and would not include, Lisogurski's error detection. Ex. 1025 at 13:7-14:10.

113. Unlike front end processing circuitry 150, which contains subcomponents that perform specific prescribed tasks related only to signal conditioning, back end processing circuitry 170 includes processor 172 that, according to Lisogurski, "may be adapted to execute software ... as part of performing the functions described herein." Ex. 1025 at 13:7-14:10, 14:56-64. A POSITA would have understood that if any component in Lisogurski's system 100 depicted in Figure 1 is configured to perform Lisogurski's error detection function, the component would be back end processing circuitry 170 with processor 172.

114. Additionally, for example, Lisogurski's error detection is disclosed as part of a "step 1904," and Lisogurski also discloses that in this step 1904, "the system may detect a physiological parameter." Ex. 1025 at 36:54-37:2. In Lisogurski's system 100 depicted in Figure 1, Lisogurski discloses that the processor 172 of in back end processing circuitry 170 "determine[s] ... physiological parameters based on the received physiological signals" that are "received from front end processing

circuitry 150." Ex. 1025 at 14:56-64. This is consistent with the back end processing circuitry 170 also performing the error detection disclosed for step 1904.

115. Additionally, I understand that Petitioners and Dr. Anthony argue that Lisogurski's error detection is based on Lisogurski's processed signals, which they allege as the claimed "output signal." Petition at 42-44 (asserting that Lisogurski's error detection is "based on ... the 'processed signals'" and that "the processed signals ... are used by Lisogurski[] ... to determine ... when [the sensor] is being worn by the user"), 35-36; Ex. 1003 at ¶¶ 196-98 (same), 145-48. Lisogurski teaches that these processed signals are sent by front end processing circuitry 150 to back end processing circuitry 170, as Petitioners and Dr. Anthony acknowledge. Ex. 1025 at 12:42-45 ("front end processing circuitry 150 ... provide[s] ... processed signals to back end processing circuitry 170"); Petition at 35-36; Ex. 1003 at ¶¶ 145-48. This is shown by the following annotated version of Lisogurski's Figure 1 from the Petition and Dr. Anthony's declaration, in which Petitioners and Lisogurski identify Lisogurski's processed signals as the claimed "output signal":

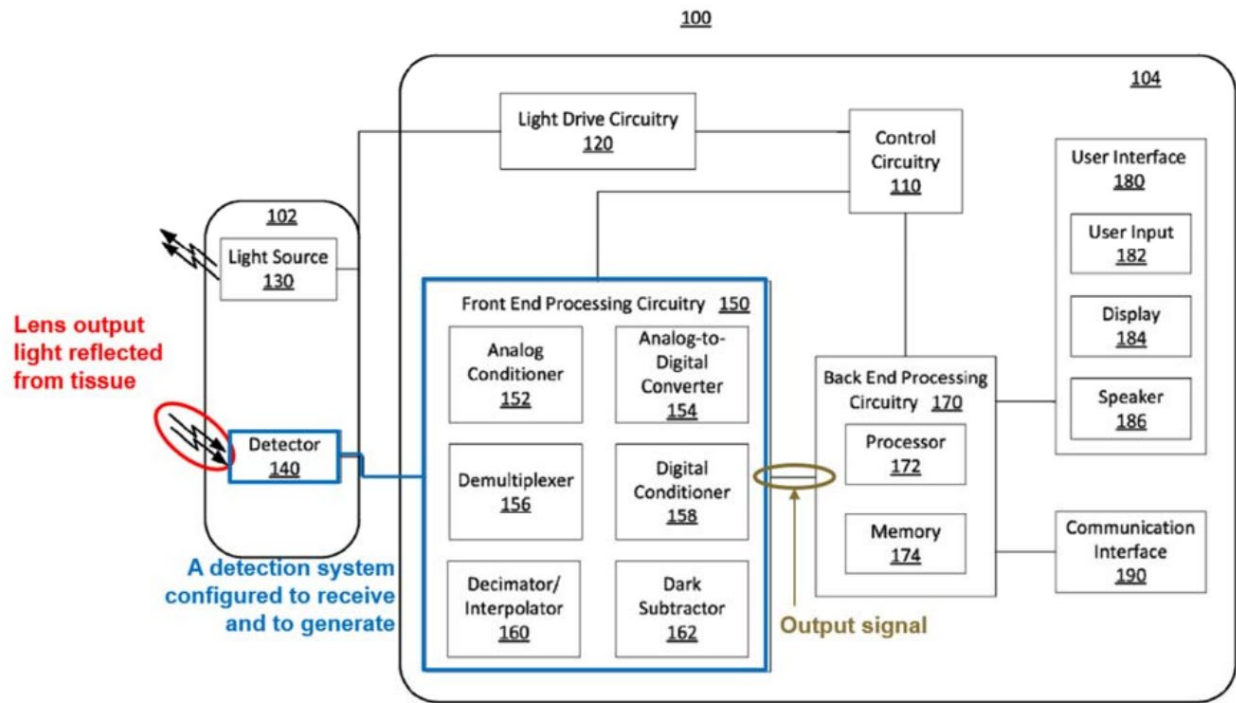


FIG. 1

Petition at 35-36 (including this annotated version of Lisogurski's Figure 1); Ex.

1003 at ¶¶ 145-48 (same).

116. A POSITA would have understood that if Lisogurski's error detection is based on the processed signals as Petitioners and Dr. Anthony allege, then, because those processed signals are received by back end processing circuitry 170, the error detection must be performed by the back end processing circuitry 170. Ex. 1025 at FIG. 1, 12:42-45. If Lisogurski's error detection is based on the processed signals as Petitioners and Dr. Anthony assert, then a POSITA would have understood that the error detection is not performed by the front end processing circuitry 150 that produces and sends the processed signals. Ex. 1025 at FIG. 1, 12:42-45.

117. For at least these reasons, Lisogurski neither discloses nor renders obvious that its sensor (alleged "apparatus") performs the error detection (alleged "determin[ation]").

d) Lisogurski does not disclose or render obvious that the error detection (alleged "determin[ation]") is based on the processed signals (alleged "output signal")

118. In my opinion, the recited requirement (*B*) that the "determin[ation] ... that the apparatus is being worn by the user" must be "based at least in part on the output signal" is not met. Lisogurski does not disclose or render obvious that Lisogurski's error detection, which is alleged to be the claimed "determin[ation] ... that the apparatus is being worn by the user," is "based at least in part on" Lisogurski's processed signals (alleged "output signal") that are sent from front end processing circuitry 150 to back end processing circuitry 170.

119. Lisogurski does not disclose that its error detection is based on the processed signals sent from front end processing circuitry 150 to back end processing circuitry 170 in system 100 shown in Figure 1. Petition at 42-44, 35-36; Ex. 1003 at ¶¶ 196-98, 145-48. The error detection is only discussed in Lisogurski in a single sentence at 36:66-37:2, which contains Lisogurski's only mention of "error," "physiologically impossible value," and "probe-off signal." Ex. 1025 at 36:66-37:2. This single disclosure of Lisogurski's error detection contains no

connection to system 100 shown in Figure 1 and no discussion of Lisogurski's processed signals or any indication that the error detection is based on those processed signals. Ex. 1025 at 36:54-37:5. Lisogurski merely states that "the system may detect a signal indicative of a system error such as a physiologically impossible value[] [or] a probe-off signal." Ex. 1025 at 36:66-37:2. This disclosure does not indicate what, if anything, this "signal" relates to in the context of Lisogurski's system 100. Lisogurski does not disclose or suggest to a POSITA that the error detection is based on Lisogurski's processed signals.

120. Petitioners and Dr. Anthony have not provided an explanation or supporting evidence for why a POSITA would have understood or found obvious that Lisogurski's error detection is based on Lisogurski's processed signals (alleged "output signal"). Petition at 42-44; Ex. 1003 at ¶¶ 196-98.

121. Petitioners and Dr. Anthony's analysis of limitation [1.n] does not include any citations to Lisogurski regarding the processed signals. The only citations to Lisogurski in Petitioners and Dr. Anthony's analysis of limitation [1.n] are to portions of Lisogurski that do not mention or relate to the processed signals that they rely upon as the claimed "output signal" in limitation [1.n]. Petition at 42-44 (citing Ex. 1025 only at 36:66-37:2 and 15:66-16:4, which do not mention or relate to Lisogurski's processed signals); Ex. 1003 at ¶¶ 196-98 (same).

122. The only citations that Petitioners and Dr. Anthony provide to allegedly support their assertions regarding Lisogurski's "processed signals" for limitation [1.n] are cross-references to their analysis of limitation [1.f] (i.e., Section IX.B.3.g.[1.f] of the Petition and IX.A.3.g.[1.f] of Dr. Anthony's declaration). Petition at 42-44 (citing "§IX.B.3.g.[1.f]"); Ex. 1003 at ¶¶ 196-98 (citing "Section IX.A.3.g.[1.f]"). But Petitioners and Dr. Anthony's analysis of limitation [1.f] does not address Lisogurski's error detection that they rely on for limitation [1.n], and thus cannot show that the error detection is based on Lisogurski's processed signals. Petition at 35-36 (§IX.B.3.g.[1.f]); Ex. 1003 at ¶¶ 145-52 (Section IX.A.3.g.[1.f]).

123. I understand that Petitioners and Dr. Anthony's analysis of limitation [1.n] includes a citation to Exhibit 1058. Petition at 42-44 (citing Ex. 1058); Ex. 1003 at ¶¶ 196-98 (same). Based on my review, there is no connection between Lisogurski and Exhibit 1058 such that Exhibit 1058 would affect a POSITA's understanding of Lisogurski's error detection. A POSITA would not understand or find obvious based on unrelated Exhibit 1058 that Lisogurski's error detection is based on the processed signals sent from front end processing circuitry 150 to back end processing circuitry 170 in Lisogurski's system 100 shown in Figure 1, as Petitioners and Dr. Anthony allege. Petition at 42-44; Ex. 1003 at ¶¶ 196-98.

124. Thus, based on my review, the Petition and Dr. Anthony's declaration provide no evidence connecting Lisogurski's error detection (alleged

"determin[ation]") to Lisogurski's processed signals (alleged "output signal") for limitation [1.n].

e) Lisogurski's error detection (alleged "determin[ation]") cannot be both (i) made by the sensor (alleged "apparatus") and (ii) based on the processed signals (alleged "output signal")

125. As I explain above, Lisogurski does not disclose or render obvious that Lisogurski's error detection (alleged "determin[ation]" ... that the apparatus is being worn by the user") is either (i) performed by Lisogurski's sensor (alleged "apparatus") or (ii) based at least in part on Lisogurski's processed signals (alleged "output signal"). Petition at 42-44; Ex. 1003 at ¶¶ 196-98. A POSITA would have further understood that Lisogurski cannot disclose or render obvious **both** (i) and (ii) because these two assertions are incompatible. That is, Lisogurski's error detection cannot be both performed by the sensor and based on the processed signals as alleged.

126. This incompatibility is demonstrated by the following annotated version of Lisogurski's Figure 1 from the Petition and Dr. Anthony's declaration:

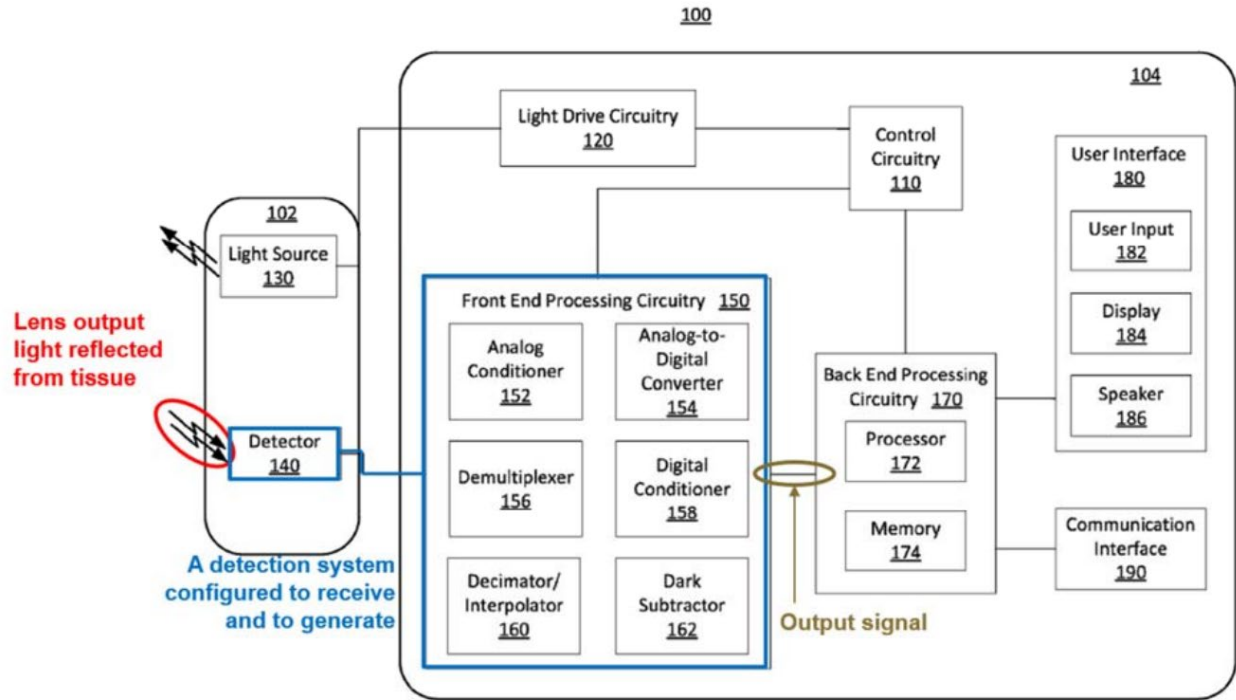


FIG. 1

Petition at 35-36 (including this annotated version of Lisogurski's Figure 1); Ex. 1003 at ¶¶ 145-48 (same). The blue annotation indicates Petitioners and Dr. Anthony's argument that Lisogurski would have been modified so that front end processing circuitry 150 is part of sensor 102. Petition at 26-28; Ex. 1003 at ¶¶ 90-107. The brown annotation indicates Lisogurski's processed signals (alleged "output signal") that are sent from front end processing circuitry 150 to back end processing circuitry 170. Petition at 35-36; Ex. 1003 at ¶¶ 145-48; Ex. 1025 at 12:42-45.

127. On one hand, a POSITA would have understood that if Lisogurski's error detection is performed by Lisogurski's sensor 102 (even assuming sensor 102 includes front end processing circuitry 150 as alleged), then the error detection cannot be based on the processed signals, which are received instead by back end

processing circuitry 170. Ex. 1025 at FIG. 1, 12:42-45. Thus, Lisogurski fails to disclose the requirement of limitation [1.n] that the error detection (alleged "determin[ation] ... that the apparatus is being worn by the user") be "based at least in part on" Lisogurski's processed signals (alleged "output signal")

128. On the other hand, a POSITA would have understood that if Lisogurski's error detection is based on Lisogurski's processed signals received by back end processing circuitry 170, then the error detection is performed by the back end processing circuitry 170 and not sensor 102 (even assuming sensor 102 includes front end processing circuitry 150 as alleged). Ex. 1025 at FIG. 1, 12:42-45. Thus, Lisogurski fails to disclose the requirement of limitation [1.n] that Lisogurski's sensor (alleged "apparatus") is "configured to" perform the error detection (alleged "determin[ation] ... that the apparatus is being worn by the user").

129. Thus, in my opinion, Lisogurski does not and cannot satisfy all aspects of limitation [1.n].

2. Dependent Claim 6

130. I disagree with Petitioners and Dr. Anthony's assertion that claim 6 is obvious over Lisogurski.

131. Claim 6 depends from independent claim 1. Petitioners and Dr. Anthony's analysis of claim 6 focuses on the additional limitations of claim 6 and does not address any of the aforementioned deficiencies regarding Lisogurski in

relation to claim 1. Petition at 44-47; Ex. 1003 at ¶¶ 199-211. Therefore, Lisogurski does not render obvious claim 6 for at least the same reasons explained in Section X.A.1 above with respect to independent claim 1.

132. Additionally, Lisogurski does not render obvious the limitations recited in claim 6, which recites, in part: "wherein the detection system comprises the plurality of detectors arranged along an *arc*," which I refer to herein as the "arc limitation." Ex. 1001 at 86:9-10 (emphasis added); Petition at ix-x. Based on my review, Petitioners and Dr. Anthony rely on Lisogurski's disclosure of a sensor with multiple detectors for the claimed "plurality of detectors." Petition at 37, 44-45; Ex. 1003 at ¶¶ 163-69, 199-202. However, Lisogurski does not disclose or render obvious that its detectors are "arranged along an arc" as recited in claim 6.

a) Previous IPRs Regarding Related Patents

133. I understand that certain portions of the Petition and Dr. Anthony's declaration rely on findings by the Board in prior IPR proceedings challenging patents related to the '475 Patent, including the '533-FWD and '484-FWD. However, the arc limitation of claim 6 of the '475 Patent is not recited in the claims of either the '533 Patent or '484 Patent, and Petitioners and Dr. Anthony do not rely on the '533-FWD or '484-FWD in their analysis of claim 6. *See* Petition at 46-47; Ex. 1003 at ¶ 209; Ex. 1081; Ex. 1082. Therefore, I understand that to the extent that Petitioners and Dr. Anthony rely on the Board's findings in the '533-FWD and '484-

FWD, those prior findings do not address the arc limitation in claim 6 of the '475 Patent.

b) Lisogurski Does Not Disclose or Render Obvious the Arc Limitation

134. Petitioners and Dr. Anthony's analysis regarding the arc limitation of claim 6 for Ground 1 consists of a single paragraph in the Petition and a single paragraph in Dr. Anthony's declaration, respectively. Petition at 46-47; Ex. 1003 at ¶ 209. Based on my review, their analysis does not show that the arc limitation of claim 6 is disclosed or rendered obvious by Lisogurski. Indeed, Lisogurski neither discloses nor renders obvious the arc limitation of claim 6.

135. Lisogurski does not disclose an "arc" arrangement as recited in claim 6. Lisogurski contains no disclosure regarding any particular arrangement of detectors, including no disclosure of an arc arrangement.

136. Petitioners and Dr. Anthony cite to Lisogurski's statement regarding "[a]ny suitable configuration." Petition at 46 (citing Ex. 1025 at 17:39-43); Ex. 1003 at ¶ 209 (same). This statement in Lisogurski about "[a]ny suitable configuration" does not disclose an arc arrangement.

137. Based on my review, Petitioners and Dr. Anthony do not identify any teaching or suggestion of an arc arrangement in Lisogurski. Petition at 46-47; Ex. 1003 at ¶ 209.

138. Lisogurski does not render obvious an "arc" arrangement of detectors as recited in claim 6.

139. Petitioners and Dr. Anthony cite to Lisogurski's statement regarding "[a]ny suitable configuration." Petition at 46 (citing Ex. 1025 at 17:39-43); Ex. 1003 at ¶ 209 (same). A POSITA would not have understood this statement in Lisogurski about "[a]ny suitable configuration" to teach or suggest any particular arrangement to begin with. Further, this statement in Lisogurski about "[a]ny suitable configuration" does not teach or suggest that any one configuration as opposed to countless other potential arrangements. For example, this statement in Lisogurski about "[a]ny suitable configuration" does not teach an arc arrangement as opposed to a linear, triangle, or other arrangement of detectors.

140. Petitioners and Dr. Anthony assert the following alleged motivation for an arc arrangement based on detection of angularly scattered light:

A POSITA would have understood (or at least found it obvious) to arrange the multiple detectors of Lisogurski's sensor in an arc configuration because a POSITA would appreciate that light emitted into biological tissue undergoes significant scattering and absorption, and the reflected light exits the tissue at a wide range of angles ... such that a linear or closely grouped detector arrangement would fail to capture much of this angularly scattered light.

Petition at 46-47 (citing Ex. 1025 at 11:16-20; Ex. 1045 at 4:14-65); *see* Ex. 1003 at ¶ 209 (citing the same). This alleged motivation regarding detection of angularly scattered light is flawed for at least two reasons.

141. Petitioners and Dr. Anthony's assertions regarding "angle[d]" light and the need for non-"linear" arrangements for angularly scattered light is unsupported by the cited evidence. Petition at 46-47 (citing Ex. 1025 at 11:16-20; Ex. 1045 at 4:14-65); Ex. 1003 at ¶ 209 (same). The cited portion of Lisogurski relates to "light intensity" based on "absorbance and/or reflectance" of a "certain wavelength" but does not address angularly scattered light or any arrangement of detectors. Ex. 1025 at 11:16-20. Lisogurski never mentions an "angle." The cited portion of Exhibit 1045 also does not discuss angled light or any connection between such angled light and an arc arrangement. Ex. 1045 at 4:14-65. And the cited portion of Exhibit 1045 describes at least one sensor with only a "single" detector. Ex. 1045 at 4:14-65 ("Yet another prototype reflectance sensor is based on eight ... LEDs and a single photodiode").

142. Petitioners and Dr. Anthony's assertion regarding the deficiency of a "linear ... detector arrangement" wrongly assumes that only two alternative arrangements existed: a "linear ... arrangement" and an arc arrangement. Petition at 46-47; Ex. 1003 at ¶ 209. They fail to consider that other potential non-linear and non-arc arrangements existed (e.g., triangle, or grid patterns, like in solar panels, or in multiple planes) and that a POSITA could have sought to capture angularly scattered light by using one of those other arrangements, not just an arc arrangement. As an example, LeBoeuf's Figure 12A teaches an arrangement of multiple detectors

26 that is neither linear nor an arc. Ex. 1026 at FIG. 12A, ¶¶ [0060], [0138].
Petitioners and Dr. Anthony do not explain why a POSITA would be motivated to choose an arc as opposed to other possible non-linear arrangements.

143. Additionally, the Petition does not identify any teaching of an arc arrangement anywhere in the prior art. Petition at 46-47. Dr. Anthony's declaration suggests that Exhibit 1045 teaches an arc arrangement, however: (i) Petitioners and Dr. Anthony do not assert Exhibit 1045 in combination with Lisogurski for Ground 1; and (ii) Petitioners and Dr. Anthony's only alleged motivation connecting Exhibit 1045 to Lisogurski is their assertion about "angularly scattered light," but as I explain above, the cited portion of Exhibit 1045 does not discuss such angled light or using an arc arrangement because of such angled light. Ex. 1045 at 4:14-65.

c) Lisogurski Does Not Disclose "Six Light Emitting Diodes"

144. Claim 6 recites "wherein the plurality of light emitting diodes comprises six light emitting diodes." Ex. 1001 at 86:7-8.

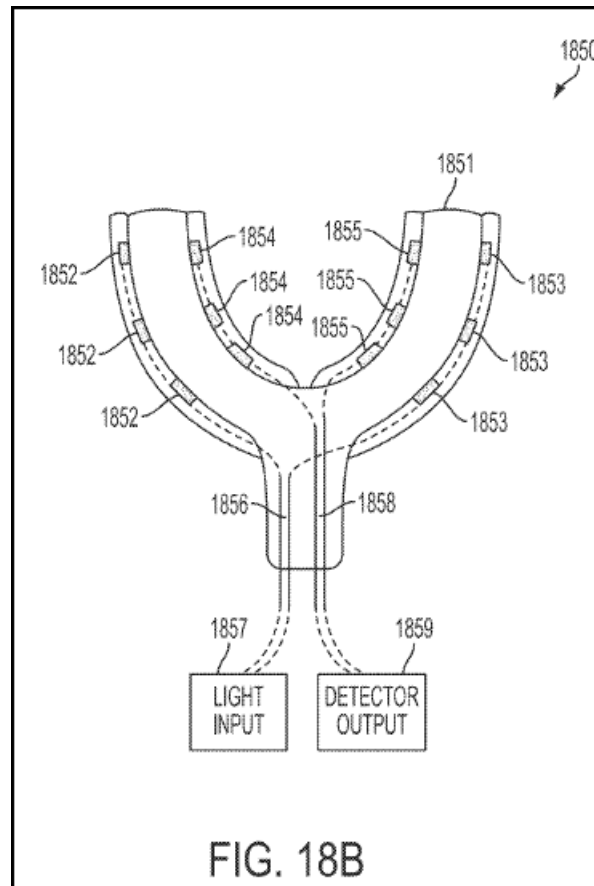
145. Dr. Anthony agreed that "six light-emitting diodes" is a new limitation not addressed by the prior '484 and '533 IPR decisions:

Q. And so the requirement of six light-emitting diodes is a new limitation relative to the prior '484 and '533 IPRs. Correct?

A. Correct.

Ex. 2046 at 310:22-25.

146. The '475 patent specification specifically depicts an embodiment with six light-emitting diodes in FIG. 18B. Ex. 1001 at FIG. 18B.



Ex. 1001 at FIG. 18B

147. The '475 Patent explains that:

Similar to the clamp design describe above, the light source inputs 1852, 1853 may comprise one or more light sources directly, or they may have light guided to them from an external light source. Also, the light source inputs 1852, 1853 may comprise lens systems to collimate or focus the light across the teeth. The detector outputs 1854, 1855 may comprise one or more detectors directly, or they may have one or more light guides to transport the signals to an external detector element. The light source inputs 1852, 1853 may be coupled electrically or optically

through 1856 to a light input 1857. For example, if the light source is external in 1857, then the one or more coupling elements 1856 may be one or more light guides, such as a fiber optic. Alternately, if the light sources are contained in 1852, 1853, then the coupling element 1856 may be one or more electrical wires connecting to a power supply in 1857. Similarly, the detector outputs 1854, 1855 may be coupled to a detector output unit 1859 with one or more coupling elements 1858, which may be one or more electrical wires or one or more light guides, such as a fiber optic. This is just one example of a mouth guard design covering a plurality of teeth, but other embodiments may also be used and are intended to be covered by this disclosure.

Ex. 1001 at FIG. 18B, 27:46-28:1. From the disclosure of the '475 Patent specification, a person of ordinary skill in the art would understand that the use of six LEDs provides the technical advantage of increasing the probability that emitted light will illuminate blood vessels within the tissue—a requirement for accurate physiological measurement. At wearable device measurement sites such as the wrist or teeth (EX 1001 at 23:55-61), the microvasculature is not uniformly distributed beneath the skin surface. Six spatially distributed LEDs illuminate the tissue from six distinct locations, substantially increasing the statistical probability that at least some of the emitted light will pass through or reflect from a region with adequate blood vessel density to produce a measurable physiological signal. In addition, using six LEDs provides sufficient redundancy for each wavelength used without reducing LED efficiency. For example, when a system uses three distinct wavelengths—six LEDs provide exactly two LEDs per wavelength. This two-per-wavelength pairing is not an arbitrary selection; it provides meaningful redundancy for each wavelength

channel while maintaining system efficiency.

148. For this claim element, Dr. Anthony relies on Lisogurski's use of generic terms like "one or more," "multiple," and "any number" of LEDs. Ex. 1003 at ¶ 203. Based on my review, Lisogurski does not disclose the specific requirement that the plurality of semiconductor sources comprises six light emitting diodes. Lisogurski teaches that its light source "may include any number of light sources with any suitable characteristics," "multiple light sources," "may be one or more LEDs," and that "the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof." Ex. 1025 at 10:58-60, 17:43-45, 19:22-31. These generic disclosures of "one or more," "multiple," and "any number" do not expressly disclose six. The only specific embodiment described in Lisogurski uses two LEDs—one red and one infrared. Ex. 1025 at 10:52-56.

149. Lisogurski's stated objectives counsel against using six LEDs. Lisogurski is entitled "Methods and Systems for Power Optimization in a Medical Device" and is fundamentally directed to reducing power consumption and minimizing heating effects. Ex. 1025 at Title, 1:10-25. Lisogurski teaches that "reducing power consumption may allow for increased battery life in portable

systems or increased portability." Ex. 1025 at 1:16-18. It also explains that "it may be desirable to reduce the power consumption of the light source, while still enabling high quality physiological parameters to be determined," Ex. 1025 at 3:50-53. And it teaches that "varying light output during a cardiac cycle may reduce heating effects of the emitters" (Ex. 1025 at 1:17-19). Lisogurski further expressly states a "desir[e] to reduce the power consumption by the light drive signal to reduce heating effects caused by an emitter." Ex. 1025 at 3:58-60. These disclosures align with Lisogurski's stated system objectives.

150. Tripling the number of LEDs from the two disclosed in Lisogurski to the claimed six would cut against Lisogurski's stated objectives. Ex. 1025 at 1:10-25, 3:50-60. Increasing the LED count would increase power consumption, which would undermine Lisogurski's power-optimization goal. It would also increase heat generation, contrary to Lisogurski's express aim to reduce heating effects. Increasing the LED count would further increase signal-processing complexity. Lisogurski's drive-cycle modulation sequences LEDs with intervening dark periods (Ex. 1025 at 12:16-41), and adding four additional LEDs would require additional drive periods, dark periods, and corresponding processing for each wavelength. More LEDs would also tend to increase sensor size, conflicting with Lisogurski's portability objective. Ex. 1025 at 1:15-18.

151. Consistent with these objectives, Lisogurski teaches techniques intended to minimize the number and brightness of LEDs operating at any given time, including "operat[ing] a first light source at full or regular brightness, while operating one or more additional light sources in a switched or otherwise modulated mode" to save power. Ex. 1025 at 7:38–8:3. A POSITA reading Lisogurski would understand the disclosed system is optimized for fewer LEDs, not more, and would not be motivated to triple the LED count from two to six.

152. Dr. Anthony cites LeBoeuf regarding using different wavelengths, and for Ground 2, Dr. Anthony relies on LeBoeuf's Figure 8B as depicting a plurality of optical emitters 24 for the claim limitation "wherein the detection system comprises the plurality of detectors arranged along an arc." Ex. 1003 at ¶¶ 205, 308-316; Ex. 1001 at 86:7-11. However, LeBoeuf's Figure 8B shows only four LEDs. Ex. 1026 at FIG. 8B. LeBoeuf's paragraph [0123] describes "[v]arious configurations and arrangements of optical emitters and detectors" that "may be utilized," without specifying any particular number of emitters. Ex. 1026 at [0123].

153. Dr. Anthony relies on Lamego (Ex. 1033) at paragraphs [0035] and [0041] as disclosing a sensor with "four, six, eight or sixteen LEDs of different wavelengths." Ex. 1003 at ¶ 208; Ex. 1033 at [0035], [0041]. However, Lamego is not cited as a prior art reference in any ground of unpatentability in the Petition. Petition at 8; Ex. 1003 at ¶ 70. Lamego is cited only as supplemental background

evidence in Dr. Anthony's declaration for the proposition that "using six or more LEDs for a physiological measurement device was well known in the art." Ex. 1003 at ¶ 208. Lamego offers only a bare enumeration of possible configurations and provides no teaching, preference, or selection criteria that would lead a POSITA to choose six LEDs over the other disclosed options—four, eight, or sixteen. Ex. 1033 at [0041]. Absent any such teaching, Dr. Anthony's selection of six wavelengths is arbitrary and reflects impermissible hindsight rather than a reasoned motivation grounded in prior art. Ex. 1003 at ¶ 208.

154. Lamego is entitled "Multiple-Wavelength Physiological Monitor" and discloses a multi-wavelength system designed to measure "various physiologically-related parameters" including "noise, motion, various hemodynamic parameters, and/or blood constituent concentrations and/or levels." Ex. 1033 at Title, [0035]. Lamego's system uses "four, six, eight or sixteen LEDs of different wavelengths" to address the problem that "when only two wavelengths are used but there are more than two significant absorbers in the patient's tissue, the system may be underdetermined." Ex. 1033 at [0035], [0041]. Lamego's system is designed for multi-constituent spectral analysis—a different measurement task than Lisogurski's single-parameter pulse oximetry. The "underdetermined" problem described in Lamego—"when only two wavelengths are used but there are more than two significant absorbers" (Ex. 1033 at [0035])—does not arise in Lisogurski's system

because Lisogurski is designed to measure only two absorbers. Dr. Anthony does not explain why Lisogurski's system is "underdetermined" or identify any "additional significant absorbers" that would necessitate additional wavelengths. Ex. 1003 at ¶¶199-208. Dr. Anthony's declaration does not explain why a POSITA would have a motivation to combine Lisogurski with LeBoeuf and/or Lamego. Ex. 1003 at ¶¶ 199-208. Dr. Anthony's declaration also does not explain why a POSITA would have chosen six LEDs over other numbers, nor does it identify any technical reason or advantage for using specifically six LEDs in a pulse oximetry system. Ex. 1003 at ¶¶ 199-208. The mere listing of six as one of several options in Ex. 1033, without any explanation of why six would be preferred, does not supply the requisite motivation.

3. Dependent Claim 7

155. I disagree with Petitioners and Dr. Anthony's assertion that claim 7 is obvious over Lisogurski.

156. Claim 7 depends from both claims 1 and 6, as claim 7 depends from claim 6 that depends from independent claim 1. Petitioners and Dr. Anthony's analysis of claim 7 focuses on the additional limitations of claim 7 and does not address any of the aforementioned deficiencies regarding Lisogurski in relation to claims 1 and 6. Petition at 47-49; Ex. 1003 at ¶¶ 212-21.

157. Therefore, Lisogurski does not render obvious claim 7 for at least the same reasons explained in Section X.A.1 above with respect to independent claim 1 and in Section X.A.2 above with respect to claim 6.

4. Independent Claim 8

158. I disagree with Petitioners and Dr. Anthony's assertion that claim 8 is obvious over Lisogurski. Claim 8 recites substantially identical "determine ... that the wearable device is being worn by the user" limitations as claim 1. Ex. 1001 at 86:44-46 (claim 8). Petitioners and Dr. Anthony do not address the same deficiencies regarding claim 1 because Lisogurski's "probe-off" system error is different from determining the apparatus "is being worn by the user". *See* Section X.A.1.

159. Claim 8 of the '475 Patent includes limitations [8.d] and [8.g] that together recite:

[8.d]: "a processor configured to: ... "

[8.g]: "(iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user."

Ex. 1001 at 86:26, 86:44-46. In my opinion, a POSITA would understand that together these limitations [8.d] and [8.g] recites the following requirements:

- (C) The claimed "determin[ation] ... that the wearable device is being worn by the user" must be made by the "processor"; and
- (D) This "determin[ation] ... that the apparatus is being worn by the user" must be "based at least in part on the third output signal."

160. Based on my review, Petitioners and Dr. Anthony argue that limitation [8.g]'s "determin[ation] ... that the wearable device is being worn by the user" (which I may refer to herein as the claimed "determin[ation]") is taught by Lisogurski disclosure of "detect[ing]" a "system error" in the form of a "physiological impossible value" or "probe-off signal." Petition at 54-56 (citing Ex. 1025 at 36:66-7:2); Ex. 1003 at ¶¶ 248-54 (same). That is, similar to their argument for the "determin[ation]" in limitation [1.n], they rely upon the following disclosure in Lisogurski for the claimed "determin[ation]" in limitation [8.g]:

In some embodiments, the system may detect a signal indicative of a system error such as a physiologically impossible value[] [or] a probe-off signal

Ex. 1025 at 36:66-7:2; *see* Petition at 54-56; Ex. 1003 at ¶¶ 248-54. As noted in my discussion regarding limitation [1.n] above, I may refer herein to this disclosure as Lisogurski's "error detection."

161. As discussed in Section X.A.1.b, Lisogurski's disclosed error detection (Ex. 1025 at 36:66-37:2) does not meet the claim language in limitation [1.n] of "determine ... that the apparatus is being worn by the user" as Petitioners and Dr. Anthony allege.

162. For the claimed "processor" recited in limitation [8.d] that is implicated in limitation [8.g], Petitioners and Dr. Anthony rely on Lisogurski's front end processing circuitry 150. Petition at 50-51; Ex. 1003 at ¶¶ 236-238. They also argue

that Lisogurski would have been modified such that this front end processing circuitry 150 is located in sensor 102. Petition at 26-28; Ex. 1003 at ¶¶ 90-107.

163. For the claimed "third output signal" recited in limitation [8.g], Petitioners and Dr. Anthony argue that this "third output signal" (which is first recited in limitation [8.f]) is met by Lisogurski's alleged teaching of "an output signal generated after application of a dark subtraction technique." Petition at 52-56; Ex. 1003 at ¶¶ 244-254. Petitioners and Dr. Anthony refer to this alleged output signal as a "'dark subtract[ed]' signal," and for convenience and clarity, I will do the same herein.¹ Petition at 54-56; Ex. 1003 at ¶¶ 248-254. According to Petitioners and Dr. Anthony such an alleged "output signal" is sent from front end processing circuitry 150 to back end processing circuitry 170. Petition at 35-36; Ex. 1003 at ¶¶ 145-148.

164. Thus, regarding the two requirements (C) and (D) that I note above for limitations [8.g] and, by implication, [8.d], I understand that Petitioners and Dr.

¹ By discussing this alleged "'dark subtract[ed]' signal" herein, I do not acknowledge or concede that Lisogurski teaches such a "'dark subtract[ed]' signal" or that such a signal constitutes an alleged "output signal" as Petitioners and Dr. Anthony allege. For purposes of my analysis, I assume Lisogurski's teaching of a "'dark subtract[ed]' signal" is an "output signal" as they allege. Even with that assumption, Lisogurski does not disclose or render obvious limitation [8.g] together with limitation [8.d].

Anthony must show that Lisogurski's error detection (alleged "determin[ation]") is performed by Lisogurski's front end processing circuitry 150 (alleged "processor") using Lisogurski's (alleged "output signal"). Petition at 50-56; Ex. 1003 at ¶¶ 236-38, 244-54.

165. I understand that limitations [1.n] and [8.g], and Petitioners and Dr. Anthony's positions regarding these two limitations, are **similar** because both recite a "determin[ation]" that either the claimed "apparatus" of limitation [1.n] or "wearable device" of limitation [8.g] "is being worn by the user," and Petitioners and Dr. Anthony rely upon Lisogurski's error detection for this claimed "determin[ation]" in both limitations [1.n] and [8.g]. Ex. 1001 at 85:48-50, 86:44-46; Petition at 42-44, 54-56; Ex. 1003 at ¶¶ 196-98, 248-54.

166. However, limitations [1.n] and [8.g], and Petitioners and Dr. Anthony's positions regarding these two limitations, are **different** in two ways.

167. First, limitation [1.n] recites that the "determin[ation]" is made by the claimed "apparatus," for which Petitioners and Dr. Anthony rely on Lisogurski's sensor 102. Ex. 1001 at 85:48-50; Petition at 42-44; Ex. 1003 at ¶¶ 196-98. Limitation [8.g] and, by implication, limitation 8[d] instead recite that the "determin[ation]" is made by limitation [8.d]'s claimed "processor," for which Petitioners and Dr. Anthony rely more specifically on Lisogurski's front end

processing circuitry 150 allegedly within sensor 102. Ex. 1001 at 86:26, 86:44-46; Petition at 50-51, 26-28; Ex. 1003 at ¶¶ 236-38.

168. Second, limitation [1.n] recites that the "determin[ation]" is "based at least in part on the output signal," for which Petitioners and Dr. Anthony rely on Lisogurski's processed signals that are sent to back end processing circuitry 170. Ex. 1001 at 85:48-50; Petition at 42-44, 35-36; Ex. 1003 at ¶¶ 196-98, 145-48. Limitation [8.g] instead recites that the "determin[ation]" is "based at least in part on the *third* output signal" (emphasis added), for which Petitioners and Dr. Anthony rely more specifically on Lisogurski's alleged "'dark subtract[ed]' signal." Ex. 1001 at 86:26, 86:44-46; Petition at 54-56, 52-54; Ex. 1003 at ¶¶ 248-54, 244-27.

169. Even assuming that Lisogurski's error detection constitutes limitation a "determin[ation] ... that the wearable device is being worn by the user" as alleged, Lisogurski does not disclose or render obvious that this error detection is either made by Lisogurski's front end processing circuitry (alleged "processor") or based at least in part on Lisogurski's purported "'dark subtract[ed]' signal" (alleged "third output signal") according to the recited requirements (C) the claimed "determin[ation] ... that the wearable device is being worn by the user" must be made by the "processor," and (D) this "determin[ation] ... that the apparatus is being worn by the user" must be "based at least in part on the third output signal," respectively, as I note above.

a) Previous IPRs Regarding Related Patents

170. I understand that certain portions of the Petition and Dr. Anthony's declaration rely on findings by the Board in prior IPR proceedings challenging patents related to the '475 Patent, including the '533-FWD and '484-FWD. However, limitation [8.g], and limitation [8.d] by implication, of the '475 Patent is not recited in the claims of either the '533 Patent or '484 Patent, and Petitioners and Dr. Anthony do not rely on the '533-FWD or '484-FWD in their analysis of limitations [8.g] or [8.d]. *See* Petition at 54-56, 50-51; Ex. 1003 at ¶¶ 248-54, 236-38; Ex. 1081; Ex. 1082. Therefore, to the extent that Petitioners and Dr. Anthony rely on the Board's findings in the '533-FWD and '484-FWD, those prior findings do not address limitations [8.g] or [8.d] of the '475 Patent.

b) Lisogurski does not disclose or render obvious that the front end processing circuitry (alleged "processor") is configured to make the error detection (alleged "determin[ation]")

171. In my opinion, the recited requirement (C) that the claimed "determin[ation] ... that the wearable device is being worn by the user" must be made by the "processor" is not met. Lisogurski does not disclose or render obvious that its front end processing circuitry, which is alleged to be the claimed "processor," is configured to perform Lisogurski's error detection, which is alleged to be the claimed "determin[ation] ... that the wearable device is being worn by the user." That is, Lisogurski does not meet the claim language in limitation [8.g] and, by

implication, limitation [8.d] of "a processor configured to ... (iv) determine ... that the wearable device is being worn by the user."

172. Lisogurski does not disclose that the error detection is performed by front end processing circuitry, which Petitioners and Dr. Anthony allege is modified to be within Lisogurski's sensor. The error detection is only discussed in Lisogurski in a single sentence at 36:66-37:2, which contains Lisogurski's only mention of "error," "physiologically impossible value," and "probe-off signal." Ex. 1025 at 36:66-37:2. This single disclosure of Lisogurski's error detection contains no discussion of Lisogurski's front end processing circuitry or sensor and no indication as to what component makes the error detection. Ex. 1025 at 36:54-37:5. Lisogurski merely states that "*the system* may detect a signal indicative of a system error." Ex. 1025 at 36:66-37:2 (emphasis added). A POSITA would not have understood Lisogurski to teach that its sensor or, more particularly, its front end processing circuitry is configured to perform the error detection. Thus, Lisogurski does not disclose or suggest that its front end processing circuitry is configured to make the error detection.

173. Petitioners and Dr. Anthony have not provided an explanation, or supporting evidence, for why a POSITA would have understood or found obvious that Lisogurski's front end processing circuitry makes the error detection. Petition at 54-56; Ex. 1003 at ¶¶ 248-54.

174. Petitioners and Dr. Anthony do not address whether Lisogurski's error detection (alleged "determin[ation]") is performed by Lisogurski's front end processing circuitry (alleged "processor") because their analysis of limitation [8.g] does not mention Lisogurski's front end processing circuitry, and also, their analysis of limitation [8.d] does not mention Lisogurski's error detection. Petition at 54-56, 50-51; Ex. 1003 at ¶¶ 248-54, 236-38. Their analysis of limitation [8.g] only asserts that Lisogurski's error detection is purportedly performed by Lisogurski's sensor, which fails to address Lisogurski's front end processing circuitry (alleged "processor"). Petition at 54-56; Ex. 1003 at ¶¶ 248-54. Also, this assertion that Lisogurski's error detection is purportedly performed by Lisogurski's sensor fails for the same reasons that I explain above in Section X.A.1.c with respect to limitation [1.n] in claim 1. Petitioners and Dr. Anthony do not show any connection between Lisogurski's error detection (alleged "determin[ation]") and front end processing circuitry (alleged "processor").

175. Additionally, as I explain above with respect to limitation [1.n] in claim 1, a POSITA would have understood that Lisogurski's error detection is performed by Lisogurski's back end processing circuitry 170, not front end processing circuitry 150. Ex. 1025 at FIG. 1, 10:42-64, 11:28-32, 12:42-45, 14:56-15:18.

176. Petitioners and Dr. Anthony argue that Lisogurski would have been modified to relocate front end processing circuitry 150 from monitor 104 into sensor

102. Petition at 26-28; Ex. 1003 at ¶¶ 90-107. A POSITA would not have understood or found obvious that Lisogurski's error detection is performed by front end processing circuitry 150. Lisogurski teaches that front end processing circuitry 150 contains subcomponents that perform prescribed functions, including analog conditioner 152, analog-to-digital converter 154, demultiplexer 156, digital conditioner 158, decimator/interpolator 160, and dark subtractor 162. Ex. 1025 at FIG. 1, 13:7-14:10. A POSITA would have understood that none of these specified subcomponents of front end processing circuitry 150 performs the error detection. Ex. 1025 at FIG. 1, 13:7-14:10.

177. A POSITA would have understood that front end processing circuitry 150 is intended for signal conditioning, to condition the signal from detector 140 and send a processed signal to back end processing circuitry 170 for back end processing circuitry 170 to perform tasks such as decision-making and detection. Ex. 1025 at FIG. 1, 12:42-51, 13:7-14:10, 14:56-15:18. This signal conditioning performed by the front end processing circuitry is different from, and would not include, Lisogurski's error detection. Ex. 1025 at 13:7-14:10.

178. Unlike front end processing circuitry 150, which contains subcomponents that perform specific prescribed tasks related only to signal conditioning, back end processing circuitry 170 includes processor 172 that, according to Lisogurski, “may be adapted to execute software ... as part of

performing the functions described herein.” Ex. 1025 at 13:7-14:10, 14:56-64. A POSITA would have understood that if any component in Lisogurski’s system 100 depicted in Figure 1 is configured to perform Lisogurski’s error detection function, the component would be back end processing circuitry 170 with processor 172.

179. Additionally, for example, Lisogurski’s error detection is disclosed as part of a “step 1904,” and Lisogurski also discloses that in this step 1904, “the system may detect a physiological parameter.” Ex. 1025 at 36:54-37:2. In Lisogurski’s system 100 depicted in Figure 1, Lisogurski discloses that processor 172 of back end processing circuitry 170 “determine[s] ... physiological parameters based on the received physiological signals” that are “received from front end processing circuitry 150.” Ex. 1025 at 14:56-64. This is consistent with the back end processing circuitry 170 also performing the error detection disclosed for step 1904.

180. Additionally, Petitioners and Dr. Anthony argue that Lisogurski's error detection is based on Lisogurski's purported "'dark subtract[ed]' signal," which they allege as the claimed "third output signal." Petition at 54-56 (asserting that Lisogurski's error detection "would be based ... on the 'dark subtract[ed]' signal"), 52-54; Ex. 1003 at ¶¶ 248-54 (similar), 244-27. Petitioners and Dr. Anthony acknowledge that such an alleged "output signal" is sent from front end processing circuitry 150 to back end processing circuitry 170, as shown by the following

annotated version of Lisogurski's Figure 1 from the Petition and Dr. Anthony's declaration:

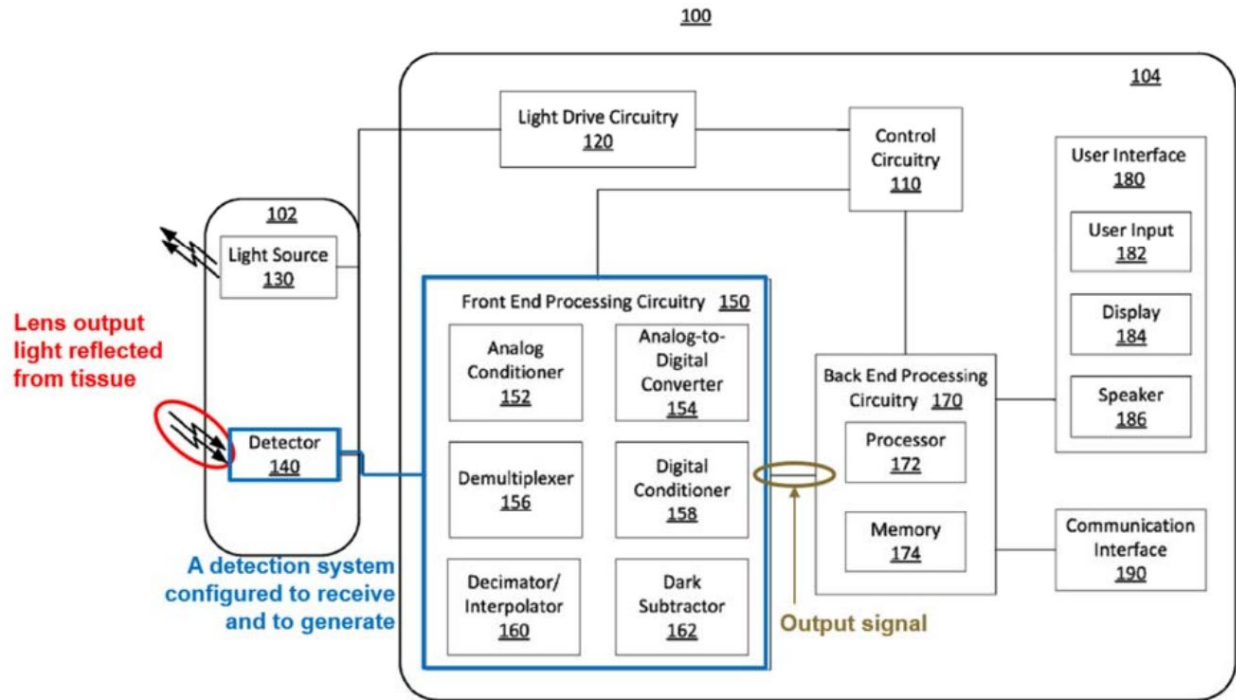


FIG. 1

Petition at 35-36; Ex. 1003 at ¶¶ 145-48. A POSITA would have understood that if Lisogurski's error detection is based on Lisogurski's purported "'dark subtract[ed]' signal" as an alleged "[third] output signal" as Petitioners and Dr. Anthony assert, then because this alleged "[third] output signal" is received by back end processing circuitry 170, the error detection must be performed by the back end processing circuitry 170. Ex. 1025 at FIG. 1, 12:42-45; Petition at 54-56, 35-36; Ex. 1003 at ¶¶ 248-54, 148. If Lisogurski's error detection is based on an alleged "[third] output signal" as Petitioners and Dr. Anthony assert, then a POSITA would have understood that the error detection is not performed by the front end processing

circuitry 150 that produces and sends this "output signal." Ex. 1025 at FIG. 1, 12:42-45; Petition at 54-56, 35-36; Ex. 1003 at ¶¶ 248-54, 148.

181. Therefore, Lisogurski neither discloses nor renders obvious that its front end processing circuitry 150 (alleged "processor") performs the error detection (alleged "determin[ation]").

c) Lisogurski does not disclose or render obvious that the error detection (alleged "determin[ation]") is based on the purported "'dark subtract[ed]' signal" (alleged "third output signal")

182. In my opinion, the recited requirement (*D*) that the "determin[ation] ... that the apparatus is being worn by the user" must be "based at least in part on the third output signal" is not met. Lisogurski does not disclose or render obvious that Lisogurski's error detection, which is alleged to be the claimed "determin[ation] ... that the wearable device is being worn by the user," is "based at least in part on" Lisogurski's purported "'dark subtract[ed]' signal" (alleged "third output signal").

183. Lisogurski does not disclose that the error detection is based on a purported "'dark subtract[ed]' signal," as Petitioners and Dr. Anthony assert. Petition at 54-56; Ex. 1003 at ¶¶ 248-54. Based on my review, the error detection is only discussed in Lisogurski in a single sentence at 36:66-37:2, which contains Lisogurski's only mention of "error," "physiologically impossible value," and "probe-off signal." Ex. 1025 at 36:66-37:2. This single disclosure of Lisogurski's

error detection contains no connection to Lisogurski's disclosures regarding dark subtraction and no discussion of Lisogurski's purported "'dark subtract[ed]' signal" or any indication that the error detection is based on such a purported "'dark subtract[ed]' signal." Ex. 1025 at 36:54-37:5. Lisogurski merely states that "the system may detect a signal indicative of a system error, such as a physiologically impossible value[] [or] a probe-off signal." Ex. 1025 at 36:66-37:2. This disclosure does not indicate what, if anything, this "signal" relates to in the context of Lisogurski's system or Lisogurski's disclosures regarding dark subtraction. In my opinion, Lisogurski does not disclose or suggest to a POSITA that the error detection is based on a purported "'dark subtract[ed]' signal."

184. Petitioners and Dr. Anthony have not provided an explanation, or supporting evidence, for why a POSITA would have understood or found obvious that Lisogurski's error detection is based on Lisogurski's purported "'dark subtract[ed]' signal" (alleged "third output signal"). Petition at 54-56; Ex. 1003 at ¶¶ 248-54.

185. Petitioners and Dr. Anthony's analysis of limitation [8.5] does not include any citations to Lisogurski regarding the purported "'dark subtract[ed]' signal." The only citations to Lisogurski in Petitioners and Dr. Anthony's analysis of limitation [8.g] are to portions of Lisogurski that do not mention or relate to dark subtraction or the purported "'dark subtract[ed]' signal" that they rely upon as the

claimed "third output signal" in limitation [8.g]. Petition at 54-56 (citing Ex. 1025 only at 36:66-37:2 and 16:12-14, which do not mention or relate to Lisogurski's dark subtraction or a purported "'dark subtract[ed]' signal"); Ex. 1003 at ¶¶ 248-54 (same). The cited portions of Lisogurski do not teach any connection between Lisogurski's error detection and Lisogurski's purported "'dark subtract[ed]' signal." Ex. 1025 at 36:66-37:2, 16:12-14

186. Petitioners and Dr. Anthony also attempt to support their assertion regarding Lisogurski's purported "'dark subtract[ed]' signal" for limitation [8.5] by citing to their analysis of limitation [1.n] (i.e., Section IX.B.3.o.[1.n] of the Petition and IX.A.3.o.[1.n] of Dr. Anthony's declaration). Petition at 54-56 (citing "§IX.B.3.o.[1.n]"); Ex. 1003 at ¶¶ 248-53 (citing "Section IX.A.3.o.[1.n]"). But Petitioners and Dr. Anthony's analysis of limitation [1.n] does not address Lisogurski's purported "'dark subtract[ed]' signal" that they rely on for limitation [8.g] and thus cannot show that Lisogurski's error detection is based on Lisogurski's purported "'dark subtract[ed]' signal." Petition at 42-44 (§IX.B.3.o.[1.n]); Ex. 1003 at ¶¶ 196-98 (Section IX.A.3.o.[1.n]).

187. Petitioners and Dr. Anthony assert that a POSITA would have understood or found obvious that Lisogurski's error detection would be based on Lisogurski's purported "'dark subtract[ed]' signal" allegedly "to ensure accurate detection of ... 'probe-off signal' or 'physiologically impossible value,' and to avoid

a situation where noises affect such detection" and "to more accurately detect whether the sensor is being worn." Petition at 55; Ex. 1003 at ¶¶ 253 (similar). Petitioners and Dr. Anthony provide no support for this assertion regarding Lisogurski's error detection allegedly being affected by noise or being made more accurate with the purported "'dark subtract[ed]' signal." For example, as I explain above, Petitioners and Dr. Anthony's analysis for limitation [8.g] cites no evidence that mentions or relates to Lisogurski's purported "'dark subtract[ed]' signal." Petition at 54-56; Ex. 1003 at ¶¶ 248-54. For example, they cite Lisogurski at 16:12-14, but this disclosure bears no relation to Lisogurski's dark subtraction or error detection. Petition at 54-56 (citing Ex. 1025 at 16:12-14); Ex. 1003 at ¶¶ 250, 253. Based on Lisogurski's disclosures, a POSITA would not have understood or found obvious that Lisogurski's error detection regarding "a system error such as a physiologically impossible value[] [or] a probe-off signal" would be affected by noise or would be based on a purported "'dark subtract[ed]' signal" to improve accuracy, as Petitioners and Dr. Anthony assert. Ex. 1025 at 36:66-37:2.

188. Petitioners and Dr. Anthony's analysis of limitation [8.g] includes a citation to Exhibit 1057. Petition at 55-56 (citing Ex. 1057); Ex. 1003 at ¶ 254 (same). Based on my review, there is no connection between Lisogurski and Exhibit 1057 such that Exhibit 1057 would affect a POSITA's understanding of Lisogurski's error detection, Lisogurski's purported "'dark subtract[ed]' signal," or any alleged

relationship between the two. A POSITA would not understand or find obvious based on unrelated Exhibit 1057 that Lisogurski's error detection is based on a purported "'dark subtract[ed]' signal" as an alleged output signal conditioned by dark subtractor 162 of front end processing circuitry 150 and sent from front end processing circuitry 150 to back end processing circuitry 170 in Lisogurski's system 100 shown in Figure 1, as Petitioners and Dr. Anthony assert. Petition at 52-56; Ex. 1003 at ¶¶ 244-54.

189. Thus, based on my review, the Petition and Dr. Anthony's declaration provide no evidence connecting Lisogurski's error detection (alleged "determin[ation]") to Lisogurski's purported "'dark subtract[ed]' signal" (alleged "third output signal") for limitation [8.g].

d) Lisogurski's error detection (alleged "determin[ation]") cannot be both (i) made by the front end processing circuitry (alleged "processor") and (ii) based on the purported "'dark subtract[ed]' signal" (alleged "third output signal")

190. As I explain above, Lisogurski does not disclose or render obvious, as Petitioners and Dr. Anthony assert, that Lisogurski's error detection (alleged "determin[ation] ... that the wearable device is being worn by the user") is either (i) performed by Lisogurski's front end processing circuitry (alleged "processor") or (ii) based at least in part on Lisogurski's purported "'dark subtract[ed]' signal" (alleged "third output signal"). Petition at 54-56, 50-51; Ex. 1003 at ¶¶ 248-54, 236-38. A

POSITA would have further understood that Lisogurski cannot disclose or render obvious **both** (i) and (ii) because these two assertions are incompatible. Lisogurski's error detection cannot both be performed by the front end processing circuitry 150 as the claimed "processor" and be based on the purported "'dark subtract[ed]' signal" as the claimed "third output signal," as asserted.

191. This incompatibility is demonstrated by the following annotated version of Lisogurski's Figure 1 from the Petition and Dr. Anthony's declaration:

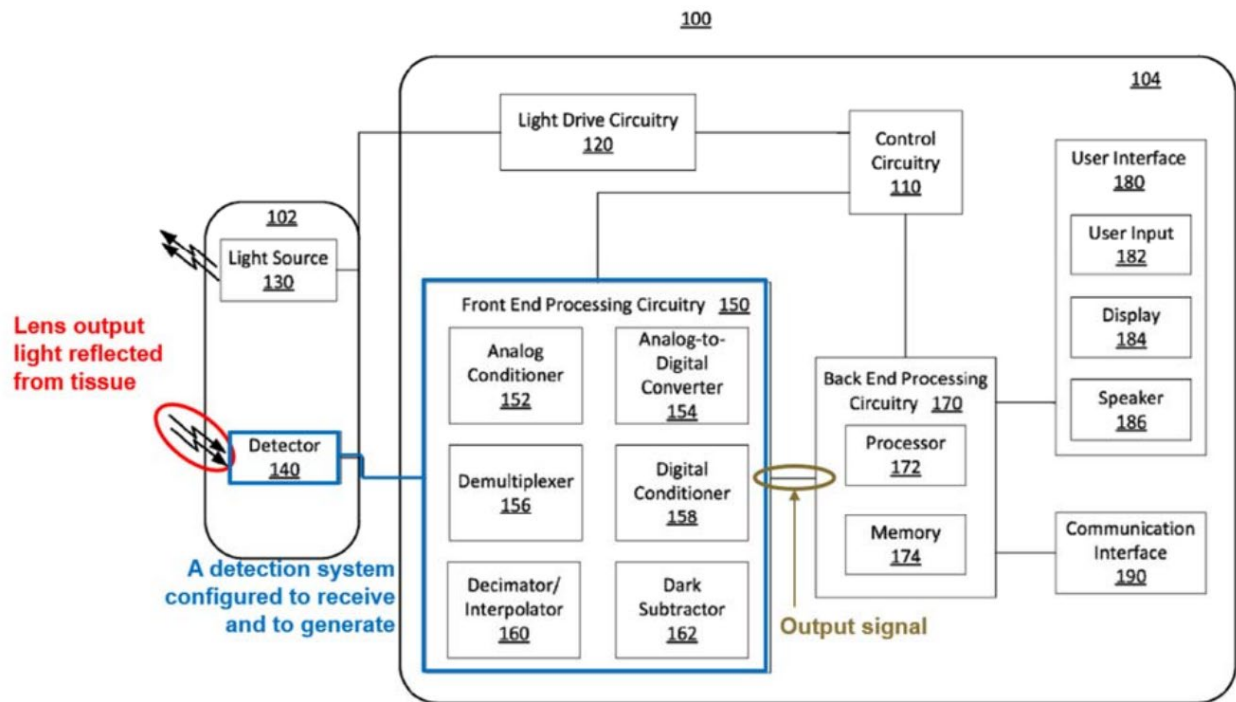


FIG. 1

Petition at 35-36 (including this annotated version of Lisogurski's Figure 1); Ex. 1003 at ¶¶ 145-48 (same). The blue annotation indicates Petitioners and Dr. Anthony's argument that Lisogurski would have been modified so that front end processing circuitry 150 is part of sensor 102. Petition at 26-28; Ex. 1003 at ¶¶ 90-

107. The brown annotation indicates that "output signal" in the claims, such as limitation [8.g]'s "third output signal," corresponds to the signal in Lisogurski sent from front end processing circuitry 150 to back end processing circuitry 170. Petition at 35-36; Ex. 1003 at ¶¶ 145-48; Ex. 1025 at 12:42-45; *see also* Petition at 50-56 (asserting that claimed "output signal[s]" are generated by front end processing circuitry 150 and relying on Lisogurski's purported "'dark subtract[ed]' signal" as the claimed "third output signal"); Ex. 1003 at ¶¶ 236-54.

192. On one hand, a POSITA would have understood that if Lisogurski's error detection is performed by Lisogurski's front end processing circuitry 150, then the error detection cannot be based on the purported "'dark subtract[ed]' signal" that, as the alleged "[third] output signal," is received instead by back end processing circuitry 170. Ex. 1025 at FIG. 1, 12:42-45; *see* Petition at 35-36, 50-56; Ex. 1003 at ¶¶ 145-58, 236-54. Thus, Lisogurski would fail to meet the requirement of limitation [8.g] that the error detection (alleged "determin[ation] ... that the wearable device is being worn by the user") be "based at least in part on" Lisogurski's purported "'dark subtract[ed]' signal" (alleged "third output signal")

193. On the other hand, a POSITA would have understood that if Lisogurski's error detection is based on Lisogurski's purported "'dark subtract[ed]' signal" that, as the alleged "[third] output signal," is received by back end processing circuitry 170, then the error detection is performed by the back end processing

circuitry 170 and not front end processing circuitry 150. Ex. 1025 at FIG. 1, 12:42-45 *see* Petition at 35-36, 50-56; Ex. 1003 at ¶¶ 145-58, 236-54. Thus, Lisogurski would fail to meet the requirement of limitations [8.g] and [8.d] that Lisogurski's front end processing circuitry 150 (alleged "processor") is "configured to" perform the error detection (alleged "determin[ation] ... that the wearable device is being worn by the user").

194. Lisogurski therefore cannot satisfy all aspects of limitation [8.g] and, by implication, limitation [8.d].

e) Dr. Anthony Does Not Show That the Third Signal-to-Noise Ratio Is Greater Than Both the First and Second Signal-to-Noise Ratios

195. Claim 8 (limitation [8.f]) recites that the processor is configured to "generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio." Ex. 1001 at 86:26-43; Ex. 1003 at ¶ 244.

196. Dr. Anthony maps: (1) the "first output signal" to Lisogurski's red and IR signals; (2) the "second output signal" to Lisogurski's dark signal when the LEDs are off; and (3) the "third output signal" to Lisogurski's dark-subtracted signal—the adjusted red and IR signals. Ex. 1003 at ¶¶ 244-247; Ex. 1025 at 12:53-13:6.

197. Dr. Anthony's declaration relies on the general assertion that dark subtraction "remove[s] ambient and background signals" and thereby "reduc[es] the detrimental effect[s] on the signal-to-noise ratio of the detection signal." Ex. 1003 at ¶ 247 (citing Ex. 1025 at 6:7-19, 13:60-14:10, 14:46-55, 16:33-54.) But this general assertion does not address the specific claim requirement that the "third signal-to-noise ratio" of the "third output signal" must be greater than both the "first signal-to-noise ratio" of the "first output signal" and the "second signal-to-noise ratio" of the "second output signal." Dr. Anthony does not provide any quantitative or qualitative analysis demonstrating that the dark-subtracted signal satisfies both requirements of claim 8.

198. Claim 8 requires "a second output signal having a second signal-to-noise ratio" and requires the "third signal-to-noise ratio" to be "greater than ... the second signal-to-noise ratio." Ex. 1001 at 86:33-43. The alleged "second output signal" as mapped by Dr. Anthony—i.e., Lisogurski's dark signal when LEDs are off—is essentially a measurement of ambient and background signals. Ex. 1003 at ¶¶ 245-246; Ex. 1025 at 6:7-19. Dr. Anthony asserts that "Lisogurski's generated dark signal ... has a signal-to-noise ratio," but Dr. Anthony never defines or explains what "signal-to-noise ratio" the dark signal purportedly has, much less explain how the signal-to-noise ratio of the adjusted red and IR signals (i.e., alleged "third signal-to-noise ratio") is purportedly "greater" than this unexplained signal-to-noise ratio

of the dark signal (i.e., alleged "second signal-to-noise ratio"). Ex. 1003 at ¶¶ 243–247.

199. Dr. Anthony fails to show that Lisogurski's dark signal has a relevant signal-to-noise ratio to begin with. For this, Dr. Anthony merely cites a statement in Lisogurski about "a detrimental effect on the signal-to-noise ratio of the detection signal," and then asserts, with no supporting evidence, that Lisogurski's dark signal "is a type of detection signal" and thus "has a signal-to-noise ratio." Ex. 1003 at ¶ 243 (citing Ex. 1025 at 14:49-50). This assertion is conclusory and unsupported, and the cited statement does not relate to Lisogurski's dark signal. Ex. 1025 at 14:49-50. In fact, the sentence preceding the cited statement that Dr. Anthony relies on in Lisogurski shows that the "detection signal" discussed in the cited statement refers to "the signal *from the light source*," and this is different from Lisogurski's dark signal because, as Dr. Anthony recognizes, the dark signal occurs when the light source is "off." Ex. 1025 at 14:49-50, 13:67-14:3; Ex. 1003 at ¶ 243. Thus, Dr. Anthony fails to show that Lisogurski's dark signal has a signal-to-noise ratio for comparison with the signal-to-noise ratio of the adjusted red and IR signals (i.e., alleged "third signal-to-noise ratio") as required for claim 8. Ex. 1003 at ¶¶ 239-243

200. Moreover, the noise environment may differ between the "LEDs off" and "LEDs on" conditions. Intrinsic noise may arise from the sensor and LED-drive circuitry, and extrinsic noise may arise from the surrounding environment. Noise

levels may also change with temperature shifts associated with turning the LEDs off or on. So, even if Lisogurski's dark signal has a relevant signal-to-noise ratio, Dr. Anthony has not shown that such signal-to-noise ratio is necessarily lower than the signal-to-noise ratio of the adjusted red and IR signals (i.e., alleged "third signal-to-noise ratio") as required for claim 8. Ex. 1003 at ¶¶ 244-247.

f) Dr. Anthony Does Not Show the "First Output Signal" and "Second Output Signal" Responsive to the Light Source Being "On"/"Off" (Claim 8)

201. Limitation [8.d] recites generating a "first output signal" responsive to the "light source being on." Ex. 1001 at 86:28-32.

202. Petitioners and Dr. Anthony's analyses of limitation [8.d] do not expressly identify the claimed "first output signal" in Lisogurski. Petition at 50-51; Ex. 1003 at ¶¶ 236-238. Rather, Petitioners and Dr. Anthony's analyses of limitation [8.d] refers to their analyses of limitations [1.f] and [1.l] for the part of limitation [8.d] that recites "a first output signal" that is "responsive to the light source being on." Petition at 50-51; Ex. 1003 at ¶ 237. But their analyses of limitations [1.f] and [1.l] refer to different signals, neither of which meets the requirement in limitation [8.d] of a "first output signal" that is "responsive to the light source being on."

203. Limitation [1.f] recites an "output signal" but does not include any limitation regarding the light sources being "on" or not. *See* Ex. 1003 at ¶ 145. And for limitation [1.f], Petitioners and Dr. Anthony rely on Lisogurski's processed

signals sent from front end processing circuitry 150 to back end processing circuitry 170 but with no discussion of such processed signals being responsive to Lisogurski's LEDs being "on" not. Petition at 35-36; Ex. 1003 at ¶¶ 145-152.

204. Because of this deficiency regarding limitation [1.f], Petitioners and Dr. Anthony additionally rely on their analyses of limitation [1.l] for limitation [8.d], as limitation [1.l] recites a "signal" responsive to an LED being "on." Petition at 50-51, 41; Ex. 1003 at ¶¶ 237, 186. But, unlike limitations [8.d] and [1.f], limitation [1.l] does not recite an "**output** signal," and for their analyses of limitation [1.l], Petitioners and Dr. Anthony rely on a **detection** signal *received* by front end processing circuitry, not the **processed** signal *sent* by front end processing circuitry 150 that Petitioners and Dr. Anthony map to the claimed "**output** signal." Petition at 41-42; Ex. 1003 at ¶¶ 186-188 (quoting the Board's finding that Lisogurski discloses the "'front end processing circuitry measuring the signal when at least one LED is on to capture a portion of the optical beam, e.g., a red signal and an IR signal, reflected from the tissue,'" and relying on the signals depicted in Lisogurski FIG. 2B).

205. For example, for limitation [1.l], Petitioners and Dr. Anthony rely on Lisogurski's FIG. 2B, which shows a **detection** signal that is generated by the sensor and received by the front end processing circuitry 150. Petition at 41-42; Ex. 1003 at ¶¶ 187-188; Ex. 1025 at 2:17-19 ("FIG. 2B shows an illustrative plot of a detector

signal that may be generated by a sensor"), 12:50-54 ("One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor"). Petitioners and Dr. Anthony distinguish between (i) Lisogurski's "detection signal" like the one that Petitioners and Dr. Anthony rely upon for limitation [1.l] and (ii) Lisogurski's "processed signals" that they rely upon as the claimed "output signal" in limitation [1.f]. Petition at 35; Ex. 1003 at ¶¶ 146-152. The alleged "output" signal in limitation [1.f] and the signal responsive to the LEDs being "on" in limitation [1.l] are two different types of signals, neither of which satisfies the requirement in limitation [8.d] of a signal that is both an "output signal" and is "responsive to the light source being on." Thus, Petitioners and Dr. Anthony's analyses of limitation [8.d]—which rely on their analyses for limitations [1.f] and [1.l]—fail to show "a first output signal" that is "responsive to the light source being on."

206. Petitioners and Dr. Anthony's analyses of limitation [8.f] identify the claimed "first output signal" as Lisogurski's "red and IR signals" discussed in the '484-FWD. Petition at 53-54 (quoting '484-FWD at 44 (citing Ex. 1025 at 6:7-19, 13:60-14:10, 16:33-54)); Ex. 1003 at ¶ 247 (quoting '484-FWD at 44). But, as the cited passages of Lisogurski show, these "red and IR signals" are *detection* signals sent to front end processing circuitry 150, not *processed* signals sent from front end

processing circuitry 170 that Petitioner and Dr. Anthony map to a claimed "**output** signal." *See* Ex. 1025 at 13:60-14:10 (discussing Red and IR components of "detection signal"); *see also* Ex. 1025 at 12:42-49 (distinguishing "detection signal" from "processed signal": "Referring back to FIG. 1, front end processing circuitry 150 may receive a *detection* signal from detector 140 and provide one or more *processed* signals to back end processing circuitry 170. The term 'detection signal' as used herein, may refer to any of the signals generated *within* front end processing circuitry 150" (emphases added)); Petition at 35 (distinguishing between (i) "processed signals," which are mapped to a claimed "output signal," and (ii) "detection signal"); Ex. 1003 at ¶¶ 146-148. Thus, Petitioners and Dr. Anthony's analyses of limitation [8.f] fail to identify a "first **output** signal."

207. Limitation [8.e] recites generating a "second output signal" responsive to the "light source being off." Ex. 1001 at 86:33-35.

208. Petitioners and Dr. Anthony's analyses of limitations [8.e] and [8.f] identify the alleged "second output signal" as Lisogurski's dark signal. Petition at 50-52; Ex. 1003 at ¶¶ 239-243, 247. But Lisogurski's dark signal is not an "**output** signal" because according to the Petition and Dr. Anthony's declaration, a claimed "output signal" maps to Lisogurski's **processed** signals sent from front end processing circuitry 150, whereas the Lisogurski's dark signal is a **detection** signal that Lisogurski distinguishes from its processed signals. *See* Petition at 52

(recognizing that Lisogurski's "dark signal ... is a detection signal"); Ex. 1003 at ¶ 243 (same); Petition at 35 (between (i) "processed signals," which are mapped to a claimed "output signal," and (ii) "detection signal"); Ex. 1003 at ¶¶ 146-148 (same); *cf.* Petition at 50-51, 53 (relying on the analysis of limitations [1.f] and [1.i], which rely on Lisogurski's processed signals for the claimed "output signal," for the claimed "[] output signal[s]" in claim 8); Ex. 1003 at ¶¶ 237, 245-246 (same).

5. Dependent Claims 11-13

209. I disagree with Petitioners and Dr. Anthony's assertion that claims 11-13 are obvious over Lisogurski.

210. Claims 11-13 each depend from independent claim 8. Petitioners and Dr. Anthony's analysis of claims 11-13 focuses on the additional limitations of claims 11-13 and does not address any of the deficiencies regarding Lisogurski in relation to claim 8. Petition at 56-59; Ex. 1003 at ¶¶ 255-69.

211. Therefore, Lisogurski does not render obvious claims 11-13 for at least the same reasons explained in Section X.A.4 above with respect to independent claim 8.

B. Ground 2: Obviousness Based on Lisogurski and Tran (Claims 5 and 7)

212. I understand that Petitioners and Dr. Anthony argue for Ground 2 that claims 5 and 7 of the '475 Patent are obvious over Lisogurski and Tran. Petition at

8, 59-66; Ex. 1003 at ¶¶ 70, 270-99. I disagree for at least the reasons provided below.

1. Dependent Claim 5

213. I disagree with Petitioners and Dr. Anthony's assertion that claim 5 is obvious over Lisogurski and Tran.

214. Claim 5 depends from independent claim 1. Petitioners and Dr. Anthony's analysis of claim 5 focuses on the additional limitations of claim 5 and does not address any of the aforementioned deficiencies regarding Lisogurski in relation to claim 1. Petition at 64-66; Ex. 1003 at ¶¶ 286-95. Petitioners and Dr. Anthony's analysis of claim 5 does not rely on Tran to cure the aforementioned deficiencies regarding Lisogurski in relation to claim 1. Petition at 64-66; Ex. 1003 at ¶¶ 286-95.

215. Therefore, Lisogurski and Tran do not render obvious claim 5 for at least the same reasons explained in Section X.A.1 above with respect to independent claim 1.

216. Additionally, Lisogurski and Tran do not render obvious the limitations recited in claim of the '475 patent which recites, in part, "wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium," which I refer to herein as the "memory limitation." Ex. 1001 at 86:1-3; Petition at ix.

217. Petitioners and Dr. Anthony rely on Lisogurski for the memory limitation in claim 5 and assert that Lisogurski's front end processing circuitry 150 constitutes the claimed "processor." Petition at 64-65; Ex. 1003 at ¶¶ 286-89. As Petitioners and Dr. Anthony recognize, however, Lisogurski does not disclose that front end processing circuitry 150 (alleged "processor") is "configured to be coupled to a non-transitory computer readable medium." Petition at 64-65; Ex. 1003 at ¶¶ 286-89. Petitioners and Dr. Anthony instead argue that a POSITA would have understood or found obvious that Lisogurski's front end processing circuitry 150 "include[s] [a] memory" that constitutes the claimed "non-transitory computer readable medium." Petition at 64-65; Ex. 1003 at ¶¶ 286-89.

218. Lisogurski does not teach or render obvious the memory limitation of claim 5 at least because (i) Lisogurski does not disclose this limitation and (ii) a POSITA would not have understood or found obvious that Lisogurski's front end processing circuitry 150 includes a memory.

a) Previous IPRs Regarding Related Patents

219. I understand that certain portions of the Petition and Dr. Anthony's declaration rely on findings by the Board in prior IPR proceedings challenging patents related to the '475 Patent, including the '533-FWD and '484-FWD. However, the memory limitation of claim 5 of the '475 Patent is not recited in the claims of either the '533 Patent or '484 Patent, and Petitioners and Dr. Anthony do not rely on

the '533-FWD or '484-FWD in their analysis of the memory limitation of claim 5. *See* Petition at 64-65; Ex. 1003 at ¶¶ 286-89; Ex. 1081; Ex. 1082. Therefore, I understand that to the extent that Petitioners and Dr. Anthony rely on the Board's findings in the '533-FWD and '484-FWD, those prior findings do not address the memory limitation in claim 5 of the '475 Patent.

b) Lisogurski Does Not Disclose the Memory Limitation

220. Lisogurski does not disclose that front end processing circuitry 150 (alleged "processor") includes a memory (alleged "non-transitory computer readable medium"). Ex. 1025 at FIG. 1, 11:28-49, 12:42-51, 13:7-14:10. Neither the Petition nor Dr. Anthony's declaration identify any disclosure in Lisogurski of a memory related to front end processing circuitry 150. Petition at 64-65; Ex. 1003 at ¶¶ 286-89. The only memory disclosed regarding Lisogurski's system 100 is memory 174 that is part of back end processing circuitry 170, not front end processing circuitry 150. Ex. 1025 at 14:56-15:18.

c) The Memory Limitation Would Not Have Been Understood or Obvious in Lisogurski

221. Petitioners and Dr. Anthony do not show that a POSITA would have understood or found obvious that Lisogurski's front end processing circuitry 150 (alleged "processor") includes a memory (alleged "non-transitory computer readable medium").

222. Petitioners and Dr. Anthony's argue that Lisogurski's front end processing circuitry 150 would include a memory because Lisogurski's back end processing circuitry 170 includes memory 174. Petition at 64-65; Ex. 1003 at ¶¶ 286-89. But the fact that Lisogurski's back end processing circuitry 170 includes memory 174 would have not taught or suggested to a POSITA that Lisogurski's front end processing circuitry 150, which is separate and different from back end processing circuitry 170, would likewise include a memory.

223. Lisogurski teaches that memory 174 is specific to back end processing circuitry 170 because memory 174 is associated with processor 172 in back end processing circuitry 170. Ex. 1025 at FIG. 1, 14:56-15:18 (Lisogurski's only description regarding memory 174). Front end processing circuitry 150, unlike back end processing circuitry 170, does not include processor 172 or a comparable processor. Ex. 1025 at FIG. 1, 13:7-14:10, 14:56-66. Instead, front end processing circuitry 150 includes specialized subcomponents that perform prescribed signal conditioning functions, including analog conditioner 152, analog-to-digital converter 154, demultiplexer 156, digital conditioner 158, decimator/interpolator 160, and dark subtractor 162. Ex. 1025 at FIG. 1, 13:7-14:10. A POSITA would have understood that these signal conditioning subcomponents of front end processing circuitry 150 are different from processor 172 and do not need a memory such as memory 174. Ex. 1025 at FIG. 1, 13:7-14:10, 14:56-66. Indeed, while Lisogurski

explicitly discloses that back end processing circuitry 170 includes memory 174, Lisogurski does not similar disclose a memory for front end processing circuitry 150. Ex. 1025 at FIG. 1, 13:7-14:10, 14:56-66.

224. Petitioners and Dr. Anthony do not articulate any specific reason why Lisogurski's front end processing circuitry 150 and its signal conditioning subcomponents need a memory or why a POSITA would have been motivated to modify Lisogurski to include a memory in front end processing circuitry 150. Petition at 64-65; Ex. 1003 at ¶¶ 286-89.

225. Petitioners and Dr. Anthony's cite two disclosures in Lisogurski as alleged support for their assertion regarding a memory in front end processing circuitry 150. Petition at 64-65 (citing Ex. 1025 at 12:42-50, 14:56-15:18); Ex. 1003 at ¶¶ 286-89 (same). They first cite to Lisogurski at 12:42-50 discloses that front end processing circuitry 150 "perform[s] various analog and digital processing of the detector signal," but Lisogurski already teaches that front end processing circuitry 150 performs such signal processing or conditioning without a memory. Ex.1025, 12:42-50, FIG. 1. Next they cite Lisogurski at 14:56-15:18, but this disclosure describes processor 172 and associated memory 174 in back end processing circuitry 170 and does not suggest that similar component would be in front end processing circuitry 150. Ex. 1025 at 14:56-15:18.

226. Additionally, a POSITA would not have understood or found obvious that Lisogurski's front end processing circuitry 150 (alleged "processor") includes a memory (alleged "non-transitory computer readable medium"), including for at least the following reasons.

227. Based on Lisogurski, a POSITA would have understood that front end processing circuitry 150 performs signal conditioning and has no need for a memory. For example, a POSITA would have understood that front end processing circuitry 150 receives a detector signal, processes and conditions that signal, and sends the processed signal, with no need for a memory to store the signals. Ex. 1025, 12:42-51, 13:7-14:10, FIG. 1.

228. A POSITA would have understood that front end processing circuitry 150 is different from back end processing circuitry 170 and does not need a memory such as memory 174 associated with processor 172 in back end processing circuitry 170. Lisogurski teaches that processor 172 in back end processing circuitry 170 is a general-purpose processor that "may be adapted to execute software, which may include an operating system and one or more applications, as part of performing the functions described herein," and that "[m]emory 174 may ... stor[e] information that can be interpreted by processor 172." Ex. 1025 at 14:56-66, FIG. 1. In contrast, Lisogurski teaches that front end processing circuitry 150 contains subcomponents that perform specific prescribed tasks related only to signal conditioning. Ex. 1025

at 13:7-14:10, FIG. 1. Thus, a POSITA would not have understood a memory to be included in front end processing circuitry 150 comparable to memory 174 included with processor 172 in back end processing circuitry 170. Ex. 1025 at 13:7-14:10, 14:56-66, FIG. 1. Indeed, a POSITA would recognize that Lisogurski expressly discloses a memory included in back end processing circuitry 170 but not included in front end processing circuitry 150. Ex. 1025 at FIG. 1, 14:56-66, 13:7-14:10.

229. Additionally, a POSITA would not have been motivated to modify Lisogurski's front end processing circuitry 150 to include a memory for the same reasons discussed above.

2. Dependent Claim 7

230. I disagree with Petitioners and Dr. Anthony's assertion that claim 7 is obvious over Lisogurski and Tran.

231. Claim 7 depends from both claims 1 and 6, as claim 7 depends from claim 6 that depends from independent claim 1. Petitioners and Dr. Anthony's analysis of claim 7 focuses on the additional limitations of claim 7 and does not address any of the deficiencies regarding Lisogurski in relation to claims 1 and 6. Petition at 66; Ex. 1003 at ¶¶ 296-99. Petitioners and Dr. Anthony's analysis of claim 7 does not rely on Tran to cure the deficiencies regarding Lisogurski in relation to claims 1 and 6. Petition at 66; Ex. 1003 at ¶¶ 296-99.

232. Therefore, Lisogurski and Tran do not render obvious claim 7 for at least the same reasons explained in Section X.A.1 above with respect to independent claim 1 and in Section X.A.2 above with respect to claim 6.

C. Ground 3: Obviousness Based on Lisogurski and LeBoeuf (Claims 6-7)

233. I understand that Petitioners and Dr. Anthony argue for Ground 3 that claims 6-7 of the '475 Patent are obvious over Lisogurski and LeBoeuf. Petition at 8; Ex. 1003 at ¶ 70; *see also* Petition at 66-72; Ex. 1003 at ¶¶ 300-19. I disagree for at least the reasons provided below.

1. Dependent Claim 6

234. I disagree with Petitioners and Dr. Anthony's assertion that claim 6 is obvious over Lisogurski and LeBoeuf.

235. Claim 6 depends from independent claim 1. Petitioners and Dr. Anthony's analysis of claim 6 focuses on the additional limitations of claim 6 and does not address any of the deficiencies regarding Lisogurski in relation to claim 1. Petition at 70-71; Ex. 1003 at ¶¶ 308-16. Petitioners and Dr. Anthony's analysis of claim 6 does not rely on LeBoeuf to cure the deficiencies regarding Lisogurski in relation to claim 1. Petition at 70-71; Ex. 1003 at ¶¶ 308-16. Therefore, Lisogurski and LeBoeuf do not render obvious claim 6 for at least the same reasons explained in Section X.A.1 above with respect to independent claim 1.

236. Additionally, Lisogurski and LeBoeuf do not render obvious the limitations recited in claim 6. I understand that claim 6 recites, in part, “six light emitting diodes.” Ex. 1001 at 86:7-8. Petitioners and Dr. Anthony’s analysis of claim 6 for Ground 3 does not address this limitation of “six light emitting diodes” because they rely on their analysis in Ground 1 and do not address the deficiencies regarding Lisogurski in relation to this limitation (discussed above for Ground 1) or rely on LeBoeuf to cure those deficiencies. Petition at 70-71; Ex. 1003 at ¶¶ 308-16. Therefore, Lisogurski and LeBoeuf do not render obvious claim 6 for at least the same reasons explained in Section X.A.2.c above with respect to claim 6.

237. I understand that claim 6 of the '475 patent also recites, in part, "wherein the detection system comprises the plurality of detectors arranged along an *arc*," which I refer to herein as the "arc limitation." Ex. 1001 at 86:9-10 (emphasis added); Petition at ix-x. Based on my review, Petitioners and Dr. Anthony rely on Lisogurski's disclosure of a sensor with multiple detectors for the claimed "plurality of detectors." Petition at 70, 37, 44-45; Ex. 1003 at ¶¶ 308-11, 163-69, 199-202. As Petitioners and Dr. Anthony recognize in Grounds 3-4, however, Lisogurski alone does not disclose any specific arrangement of its detectors, such as arranging its detectors in "an arc" as recited in claim 6. Petition at 70-71; Ex. 1003 at ¶¶ 311-14.

238. Dr. Anthony admitted that he does not rely on just Lisogurski to disclose detectors or emitters arranged along an arc:

Q. Right. Because *Lisogurski doesn't explicitly disclose detectors arranged along an arc*. Correct?

...

THE WITNESS: Again, my opinions are demonstrating how Lisogurski, in combination with LeBoeuf, meet the limitation. *I was not relying on just Lisogurski*. Lisogurski and LeBoeuf.

Ex. 2045 at 161:25-162:6 (emphases added; internal objections omitted).

Q. And when you refer to the combination, you're relying on a combination because *Lisogurski by itself doesn't expressly disclose emitters arranged along an arc*. Correct?

...

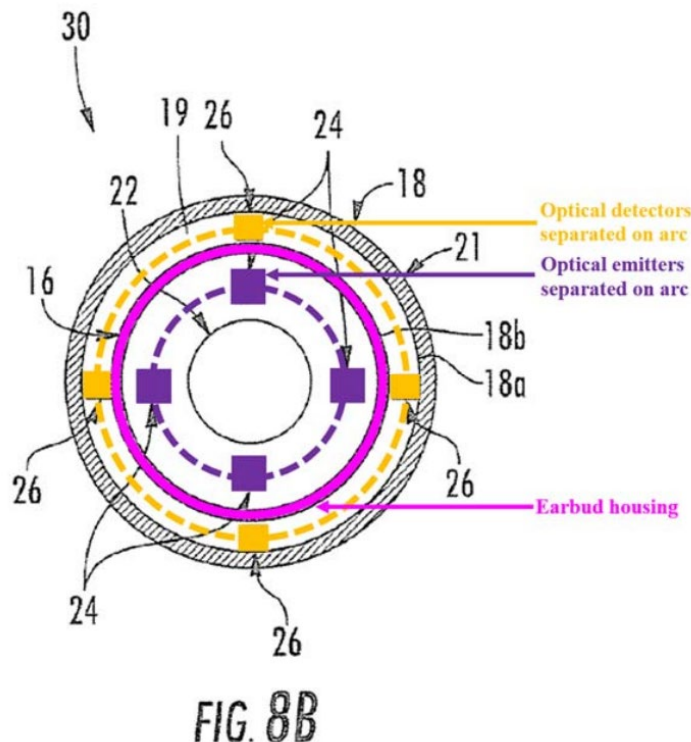
THE WITNESS: When going back to my motivations to combine, I describe why Lisogurski in -- is -- and LeBoeuf are in the same field and why LeBoeuf would solve, working together, pertinent problems, having a circular arc to address -- to absorb more of the light that's scattered through the absorption. *And in forming my opinions here, I was not, as you point out, relying just on Lisogurski*, but Lisogurski, in combination with LeBoeuf.

Ex. 2045 at 163:11-24 (emphases added; internal objections omitted).

239. Petitioners and Dr. Anthony instead rely on LeBoeuf, arguing that LeBoeuf's Figure 8B allegedly shows optical detectors 26 arranged in an arc (which

I refer to herein as the "alleged arc arrangement" in LeBoeuf) and further arguing that "a POSITA would have been motivated to apply LeBoeuf's arc arrangements to Lisogurski's sensor." Petition at 70-71 (citing "§IX.D.2" of the Petition), 68-70 (i.e., §IX.D.2: "Motivation to Combine Lisogurski and LeBoeuf"); Ex. 1003 at ¶¶ 311-14 (citing "§IX.C.2" of the Dr. Anthony's declaration), 302-06 (i.e., Section IX.C.2: "Motivation to Combine Lisogurski and LeBoeuf").

240. Petitioners and Dr. Anthony's argument includes the following annotated version of LeBoeuf's Figure 8B purporting to show this alleged arc arrangement in LeBoeuf:



Petition at 71; Ex. 1003 at ¶ 313. I note that this embodiment depicted in LeBoeuf's Figure 8B is also the same embodiment depicted in LeBoeuf's Figure 8A. Ex. 1026

at FIGS. 8A-8B, [0048]-[0049], [0123].

241. Lisogurski and LeBoeuf do not render obvious the arc limitation of claim 6, including because (i) Petitioners and Dr. Anthony do not show that a POSITA would have been motivated to implement LeBoeuf's alleged arc arrangement in Lisogurski, and (ii) a POSITA would not have been motivated to implement LeBoeuf's alleged arc arrangement in Lisogurski.

a) Previous IPRs Regarding Related Patents

242. I understand that certain portions of the Petition and Dr. Anthony's declaration rely on findings by the Board in prior IPR proceedings challenging patents related to the '475 Patent, including the '533-FWD and '484-FWD. However, the arc limitation of claim 6 of the '475 Patent is not recited in the claims of either the '533 Patent or '484 Patent. Ex. 1081; Ex. 1082.

243. Petitioners and Dr. Anthony do not rely on the '533-FWD or '484-FWD in their analysis of claim 6. *See* Petition at 70-71; Ex. 1003 at ¶¶ 308-16; Ex. 1081; Ex. 1082. Therefore, I understand that to the extent that Petitioners and Dr. Anthony rely on the Board's findings in the '533-FWD and '484-FWD, those prior findings do not address the arc limitation in claim 6 of the '475 Patent.

244. Dr. Anthony agreed that none of the claims of the '533 Patent or '484 Patent recite the word "arc":

Q. The -- none of the claims in the '533 patent recite the word "arc." Correct?

A. I agreed with you and then I went on to explain how I did not address it. In the '533, "arc" is not expressed there. ...

Q. Now, none of the claims in the '484 patent that were subject to the prior decision recite an arc. Correct?

Are you reviewing the '484 patent?

A. I am.

Again, I was not addressing, in the '48 -- prior '484, the '533, issues with the -
- associated with arc.

Ex. 2045 at 156:22-157:12.

b) LeBoeuf's Alleged Disclosure of the Arc Limitation

245. Even assuming that LeBoeuf's alleged arc arrangement meets the arc limitation of claim 6, as explained below, the combination of Lisogurski and LeBoeuf does not render obvious this arc limitation, at least because a POSITA would not have been motivated to apply LeBoeuf's alleged arc arrangement in Lisogurski.

c) Petitioners and Dr. Anthony Do Not Show that a POSITA Would Have Been Motivated to Implement LeBoeuf's Alleged Arc Arrangement in Lisogurski to Meet the Arc Limitation

246. For the arc limitation in claim 6 that recites "wherein the detection system comprises the plurality of detectors arranged along an arc," Petitioners and Dr. Anthony argue that a POSITA would have applied the alleged arc arrangement

of optical detectors 26 in LeBoeuf's Figure 8B to arrange the detectors in Lisogurski's sensor to meet this limitation. Petition at 70-71 (relying on an annotated version of LeBoeuf's Figure 8B and asserting that a POSITA would have "appl[ied] LeBoeuf's arc arrangement[] to Lisogurski's sensor"); Ex. 1003 at ¶¶ 311-14 (similar).

247. Petitioners and Dr. Anthony do not show, with sufficient explanation or supporting evidence, that a POSITA would have been motivated to implement LeBoeuf's alleged arc arrangement of optical detectors 26 to arrange Lisogurski's sensor's detectors.

248. I understand that the Petition addresses motivation to combine LeBoeuf's alleged arc arrangement with Lisogurski's system in a single paragraph in Section IX.D.2. Petition at 68-69. The Petition's analysis of claim 6 addresses motivation to combine LeBoeuf and Lisogurski in only a single sentence that refers to the one relevant paragraph in Section IX.D.2. Petition at 71 (stating "*/a/s discussed (§IX.D.2)*, a POSITA would have been motivated to apply LeBoeuf's arc arrangements to Lisogurski's sensor" (emphasis added)).

249. Dr. Anthony addresses motivation to combine LeBoeuf's alleged arc arrangement with Lisogurski's system in only two paragraphs of Section IX.C.2. Ex. 1003 at ¶¶ 303-04. Dr. Anthony's analysis of claim 6 addresses motivation to combine LeBoeuf and Lisogurski by referring to those two paragraphs of Section

IX.C.2 of his declaration. Ex. 1003 at ¶¶ 314 (stating "*[a]s I discuss in Section IX.C.2*, a person of ordinary skill in the art would have been motivated to apply LeBoeuf's teachings to Lisogurski's system" and "*[a]s I elaborate in Section IX.C.2*" (emphases added)).

250. Based on my review, Petitioners and Dr. Anthony have not provided an explanation as to *why* LeBoeuf's alleged arc arrangement of optical detectors 26 in Figure 8B would have been implemented in Lisogurski's sensor by a POSITA.

251. The relevant portions of the Petition and Dr. Anthony's declaration assert a generic motivation for implementing LeBoeuf's alleged arc arrangement of detectors in Lisogurski: "[to increase the] accuracy and reliability of [] physiological measurements." Petition at 68-69; Ex. 1003 at ¶¶ 303-04.

252. Petitioners and Dr. Anthony do not cite any disclosure in either Lisogurski or LeBoeuf to support this assertion that LeBoeuf's alleged arc arrangement achieves increased accuracy and reliability. Petitioners and Dr. Anthony do not cite any support in Lisogurski because, as they recognize, Lisogurski does not teach the alleged arc arrangement.

253. As for LeBoeuf, the relevant paragraph of the Petition cites to LeBoeuf twice, but these citations do not address LeBoeuf's alleged arc arrangement and therefore do not and cannot support the alleged motivation of accuracy and reliability: (i) Petitioners cite to paragraphs [0006] and [0010] but only regarding

LeBoeuf's device being an earbud, not regarding the alleged arc arrangement in Figure 8B; (ii) Petitioners cite to paragraph [0105] and Figure 8B to assert that "a POSITA would have been motivated to apply LeBoeuf's teaching of spatially separated detectors located on one or more arcs to improve the detection of scattered light from biological tissue, and increase the signal-to-noise ratio of Lisogurski's wearable device," but LeBoeuf contains no such teachings, including at paragraph [0105], which does not address the alleged arc arrangement in Figure 8B. Petition at 68-69 (citing Ex. 1026 at ¶¶ [0006], [0010], [0105], FIG. 8B).

254. The relevant paragraphs of Dr. Anthony's declaration only cites to LeBoeuf paragraph [0105] for the assertion that "light ... [is] reflected back out of the tissue over a broad range of angles and locations," but neither this quoted assertion nor paragraph [0105] addresses the alleged arc arrangement of detectors in Figure 8B or supports the alleged motivation of accuracy and reliability. Ex. 1003 at ¶¶ 303-04 (citing Ex. 1026 at ¶ [0105]).

255. A POSITA would have understood that the cited paragraph [0105] of LeBoeuf teaches that the detection of scattered light by optical detector 26 is enabled by light guide 18 and light-guiding region 19, which are components not addressed by Petitioners and Dr. Anthony and not included in the alleged arc arrangement. Ex. 1026 at ¶ [0105] (disclosing that "the light-guiding region 19 of the light guide 18

guides the [scattered] light to the optical detector 26 through the light-guiding region 19").

256. Neither Lisogurski nor LeBoeuf supports this alleged motivation of accuracy and reliability because (i) Lisogurski, as Petitioners and Dr. Anthony recognize, does not teach the alleged arc arrangement to begin with and (ii) LeBoeuf only discloses the alleged arc arrangement via the illustration in Figure 8B and does not contain any discussion of the alleged arc arrangement in Figure 8B, including no disclosure that the arrangement of optical detectors 26 shown in Figure 8B increases accuracy or reliability as alleged. *See* Ex. 1026 at ¶¶ [0123]-[0124]. LeBoeuf does not indicate if or how the alleged arc arrangement in Figure 8B increases the accuracy or reliability of physiological measurements.

257. The only evidence other than LeBoeuf and Lisogurski cited in the relevant paragraphs of the Petition and Dr. Anthony's declaration is Mendelson (Ex. 1045). Petition at 68-69 (citing Ex.1045, 4:14-65); Ex. 1003 at ¶¶ 303-04 (same). But the cited portion of Mendelson does not include or address the alleged arc arrangement of LeBoeuf's Figure 8B. Mendelson does not support that LeBoeuf's alleged arc arrangement of detectors achieves increased accuracy and reliability, including because, as I explain further below, the cited portion of Mendelson does not support the assertion for which it is cited.

258. Petitioners also assert that Lisogurski and LeBoeuf "[b]oth ... disclose physiological monitoring devices that can be worn on various parts of the body including the ear." Petition at 68. This assertion is not made in the relevant paragraphs of Dr. Anthony's declaration. Ex. 1003 at ¶¶ 303-04. I disagree with this assertion for the reasons discussed in the next section below. Regardless, this assertion does not support the alleged motivation of accuracy and reliability, and does not present any other alleged reason why a POSITA allegedly would have been motivated to implement LeBoeuf's alleged arc arrangement in Lisogurski.

259. Petitioners and Dr. Anthony also refer to Lisogurski's disclosure "that '[a]ny suitable configuration of light source 316 and detector 318 may be used,' and that 'sensor unit 312 may include multiple light sources and detectors, which may be spaced apart.'" Petition at 68 (quoting Ex. 1025 at 17:42-45); Ex. 1003 at ¶ 303 (same). This disclosure in Lisogurski would not have motivated a POSITA to apply LeBoeuf's alleged arc arrangement to Lisogurski, and does not support that LeBoeuf's alleged arc arrangement would increase accuracy and reliability. As discussed herein, Petitioners and Dr. Anthony have not explained why a POSITA would have understood the alleged arc arrangement of detectors in LeBoeuf's Figure 8B to have been a suitable and beneficial configuration in Lisogurski.

260. For example, LeBoeuf teaches several other arrangements involving multiple detectors (e.g., Ex. 1026 at FIGS. 6, 7A, 11A, 12A-B, 22B, 23), and

Petitioners and Dr. Anthony fail to explain why a POSITA would have been motivated to use the alleged arc arrangement in Figure 8B in particular rather than any of the other possible disclosed arrangements in LeBoeuf. Petition at 68; Ex. 1003 at ¶¶ 303-04. Even for the embodiment shown in LeBoeuf's Figure 8B, LeBoeuf discloses that "[v]arious configurations and arrangements of optical emitters and detectors may be utilized in accordance with embodiments of the present invention," which shows that LeBoeuf teaches, and a POSITA would have understood, that the alleged arc arrangement shown in Figure 8B is only a possible arrangement and not important. Ex. 1026 at [0123].

261. As another example, a POSITA would have understood that the alleged arc arrangement of detectors in LeBoeuf's Figure 8B is premised on and involves related components, including base 50, earbud housing 16, cover 18, speaker 22, and light guiding region 19. Ex. 1026 at FIGS. 8A-8B, [0123]. Petitioners and Dr. Anthony do not address those other related components, much less explain why a POSITA allegedly would have been motivated to implement LeBoeuf's alleged arc arrangement of detectors in Lisogurski without those related components. *See* Petition at 68-69; Ex. 1003 at ¶¶ 303-04. Without those related components in LeBoeuf, a POSITA would not have understood LeBoeuf's alleged arc arrangement of detectors to have been a suitable and beneficial arrangement for Lisogurski's

LEDs and detectors as Petitioners and Dr. Anthony allege. Ex. 1026 at FIGS. 8A-8B, [0123].

262. Petitioners and Dr. Anthony also assert an alleged motivation based on the detection of angularly scattered light. In the Petition, the relevant paragraph argues that "a POSITA would have been motivated to apply LeBoeuf's teaching of spatially separated detectors located on one or more arcs to improve the detection of scattered light from biological tissue," relying on the following assertions:

- (A) "Lisogurski's sensor emits light into biological tissue, and a POSITA would have understood that light emitted into biological tissue undergoes significant scattering and absorption, and the reflected light exits the tissue at a wide range of angles" (citing Ex. 1025 at 11:9-27);
- (B) "A POSITA would have recognized that a simply linear or closely grouped detector arrangement would fail to capture much of the angularly scattered light" (citing Ex. 1045 at 4:14-65).

Petition at 68-69 (citing also Ex. 1026 at [0105]). The relevant part of Dr. Anthony's declaration also makes these assertions and citations. Ex. 1003 at ¶ 304 (citing Ex. 1025 at 11:16-20; Ex. 1026 at [0105]; Ex. 1045 at 4:14-65).

263. This alleged motivation regarding detection of angularly scattered light, however, relates only to LeBoeuf's arrangement of *detectors*, not *emitters*. Petition at 68-69; Ex. 1003 at ¶ 304. That is, Petitioners and Dr. Anthony only argue assertions (A) and (B) above as alleged motivation for modifying Lisogurski based on LeBoeuf's arrangement of optical detectors 26, not LeBoeuf's arrangement of

optical emitters 24. Petition at 68-69 ("Accordingly, a POSITA would have been motivated to apply LeBoeuf's teaching of spatially separated *detectors* located on one or more arcs" (emphasis added)); Ex. 1003 at ¶ 304 (regarding "LeBoeuf's *detector arrangement*" (emphases added)).

264. According to Petitioners and Dr. Anthony, this alleged motivation of detecting angularly scattered light would not have led a POSITA to implement LeBoeuf's arrangement of optical *emitters* 24 from Figure 8B into Lisogurski. Without modifying Lisogurski to include LeBoeuf's arrangement of optical emitters 24 from Figure 8B, a POSITA would not have been motivated to include LeBoeuf's arrangement of optical detectors 26 from Figure 8B because LeBoeuf's alleged arc arrangement of detectors in Figure 8B is based on and related to the corresponding arrangement of emitters in Figure 8B (as well as other related components in Figure 8B). Ex. 1026 at FIG. 8B. Therefore, because Petitioners and Dr. Anthony's alleged motivation of detecting angularly scattered light does not provide motivation regarding LeBoeuf's arrangement of emitters, it also does not provide motivation regarding LeBoeuf's alleged arc arrangement of detectors.

265. Additionally, the alleged motivation regarding the detection of angularly scattered light based on assertions (A) "Lisogurski's sensor emits light into biological tissue, and a POSITA would have understood that light emitted into biological tissue undergoes significant scattering and absorption, and the reflected

light exits the tissue at a wide range of angles" Petition at 68-69 (citing Ex. 1025 at 11:9-27), and (B) "A POSITA would have recognized that a simply linear or closely grouped detector arrangement would fail to capture much of the angularly scattered light" Petition at 68-69 (citing Ex. 1045 at 4:14-65), is flawed at least for the following reasons. Assertion (A) about "angle[d]" light is not supported by the cited portion of Lisogurski (11:9-27), which relates to "light intensity" based on "absorbance and/or reflectance" of a "certain wavelength" but does not address angularly scattered light. Petition at 68 (citing Ex. 1025 at 11:9-27); Ex. 1003 at ¶ 304 (citing Ex. 1025 at 11:16-20). Lisogurski never mentions an "angle." Also, assertion (B) regarding the deficiency of a "linear ... detector arrangement" falsely assumes that only two alternative arrangements existed: a "linear ... arrangement" and the alleged arc arrangement in LeBoeuf's Figure 8B. Petition at 68-69; Ex. 1003 at ¶ 304.

266. Assertion (B) fails to consider that other potential arrangements existed (e.g., triangle, or grid patterns) and that a POSITA could have sought to capture angularly scattered light by using one of those other arrangements, not just the alleged arc arrangement in LeBoeuf's Figure 8B. For example, LeBoeuf itself teaches different arrangements, such as the sensor embodiment in Figure 12A that includes an arrangement of multiple detectors 26 that is neither linear nor like the alleged arc arrangement in Figure 8B, and Petitioners and Dr. Anthony do not

explain if or why the alleged arc arrangement of detectors in Figure 8B is better at detecting reflected light than the arrangement in Figure 12A. *E.g.*, Ex. 1026 at FIG. 12A, ¶¶ [0060], [0138].

267. Petitioners and Dr. Anthony's reliance on Mendelson for assertion (*B*) is flawed at least for the following reasons. Petition at 68-69 (citing Ex. 1045 at 4:14-65); Ex. 1003 at ¶ 304 (same). There is no connection between the particular alleged arc arrangement relied upon in LeBoeuf's Figure 8B and the arrangements referenced in the cited portion of Mendelson, which are different from LeBoeuf's Figure 8B. *E.g.*, Ex. 1045 at 4:14-65 (referencing a sensor with "eight ... LEDs and a single photodiode" and another sensor in a "Konig" publication (Ex. 2035)); Ex. 2035 at 5-6 ("Konig" publication disclosing a sensor with two centralized LEDs surrounded by six detectors).

268. Petitioners cite Mendelson for the assertion that "a simply linear or closely grouped detector arrangement would fail to capture much of the angularly scattered light," but the cited portion of Mendelson does not support this assertion. Petition at 68-69 (citing Ex. 1045 at 4:14-65). The cited portion of Mendelson does not discuss angles, and it describes at least one sensor with only a "single" detector. Ex. 1045 at 4:14-65 ("Yet another prototype reflectance sensor is based on eight ... LEDs and a single photodiode").

269. Dr. Anthony's declaration shows that he and Petitioners rely specifically on the following purported disclosure in Mendelson, and Dr. Anthony relies on the two underlined quotes for this purported disclosure:

For example, U.S. Pat. No. 6,801,799, which I understand has been designated as Exhibit 1045, is directed to a pulse oximeter and discloses that "in order to maximize the fraction of backscattered light collected by [a] sensor," its system includes "six photodetectors mounted in the center of the sensor *around* the LEDs." Ex. 1045 at 4:14-65 (emphasis my own).

Ex. 1003 at ¶ 304 (underlining added).

270. However, Mendelson does not contain this purported disclosure, and Dr. Anthony mischaracterizes Mendelson, because (i) the underlined quotes (i.e., Exhibit 1045, 4:23-24 and 4:45-46) refer to publications in the Background section of Mendelson, not to "its system" as Dr. Anthony alleges, and (ii) the two underlined quotes are separate and unrelated. The following excerpt from Exhibit 1045 shows that these two underlined quotes that Dr. Anthony relies upon refer to two separate, unrelated publications described in the cited Background section of Mendelson:

Another approach is based on ... the following publications:

4. Mendelson, et al., "Design and evaluation of a new reflectance pulse oximeter sensor", Medical Instrumentation, vol. 22, no. 4, pp. 167-173 (1988); and

5. Mendelson, et al., "Skin reflectance pulse oximetry: in vivo measurements from the forearm and calf", Journal of Clinical Monitoring, vol. 7, pp. 7-12, (1991).

According to this approach, in order to maximize the fraction of

backscattered light collected by the sensor, the currents from all six photodiodes are summed electronically by internal circuitry in the pulse oximeter. This configuration essentially creates a large area photodetector made of six discrete photodiodes connected in parallel to produce a single current that is proportional to the amount of light backscattered from the skin. Several studies showed that this sensor configuration could be used successfully to accurately measure SaO₂ from the forehead, forearm and the calf on humans. However, this sensor requires a means for heating the skin in order to increase local blood flow, which has practical limitations since it could cause skin burns.

Yet another prototype reflectance sensor is based on eight dual-wavelength LEDs and a single photodiode, and is disclosed in the following publication: Takatani et al., "Experimental and clinical evaluation of a noninvasive reflectance pulse oximeter sensor", Journal of Clinical Monitoring, vol. 8, pp. 257-266 (1992). ...

A similar sensor configuration based on six photodetectors mounted in the center of the sensor around the LEDs is disclosed in the following publication: Konig, et al., "Reflectance pulse oximetry—principles and obstetric application in the Zurich system", Journal of Clinical Monitoring, vol. 14, pp. 403-412 (1998).

Ex. 1045 at 4:14-50 (underlining added). Thus, Mendelson does not disclose, as Dr. Anthony purports, mounting detectors "around" LEDs to maximize light collection. Ex. 1003 at ¶ 304. Instead, the actual teaching of the first underlined quote says: "in order to maximize the ... light collected ... *the currents from all ... photodiodes are summed electronically*," which is unrelated to arrangement and instead related to an increased area of the detector. Ex. 1045 at 4:23-26 (emphasis added).

271. Additionally, Petitioners and Dr. Anthony have not provided an explanation, or supporting evidence, of specifically **how** LeBoeuf's alleged arc

arrangement of optical detectors 26 in Figure 8B would have been implemented in Lisogurski's sensor by a POSITA.

272. A POSITA would have understood that the alleged arc arrangement of detectors in LeBoeuf's Figure 8B is based on and involves related components, including base 50, earbud housing 16 (with bottom portion 16a), cover 18 (with cladding material 21), speaker 22, and light guiding region 19. Ex. 1026 at FIGS. 8A-8B, ¶¶ [0123]-[0124]. The relevant paragraphs of the Petition and Dr. Anthony's declaration do not consider or address those related components, much less explain how the alleged arc arrangement of detectors in LeBoeuf, which is based on those related components, would be implemented in Lisogurski's sensor that does not have those related components. Petition at 68-69; Ex. 1003 at ¶¶ 303-04. Petitioners and Dr. Anthony only argue that a POSITA would have been motivated to apply LeBoeuf's alleged arc arrangement of detectors to Lisogurski's sensor, not that a POSITA would have incorporated those other related components from LeBoeuf into Lisogurski. Petition at 68-69; Ex. 1003 at ¶¶ 303-04. Without incorporating those related components from LeBoeuf into Lisogurski, Petitioners and Dr. Anthony do not explain how a POSITA would have understood to apply LeBoeuf's alleged arc arrangement of detectors to Lisogurski's sensor. Ex. 1026 at FIGS. 8A-8B, ¶ [0123].

273. Petitioners and Dr. Anthony assert an alleged motivation of increased accuracy and reliability. Petition at 68-69; Ex. 1003 at ¶¶ 303-04. They do not explain if or how LeBoeuf's alleged arc arrangement of detectors would allegedly achieve such accuracy and reliability without the other related components in LeBoeuf. Petition at 68-69; Ex. 1003 at ¶¶ 303-04. Without those other related components in LeBoeuf upon which the alleged arc arrangement of detectors is based, a POSITA would not have understood the alleged arc arrangement of detectors to achieve accuracy and reliability as alleged. Ex. 1026 at FIGS. 8A-8B, ¶ [0123].

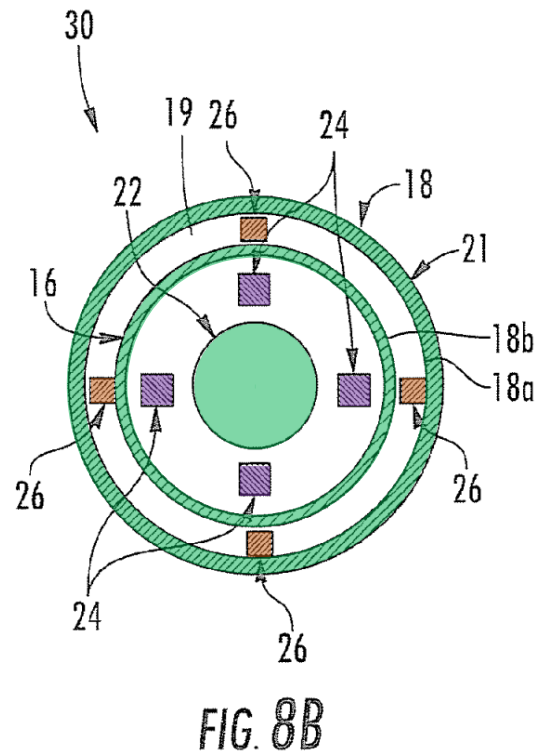
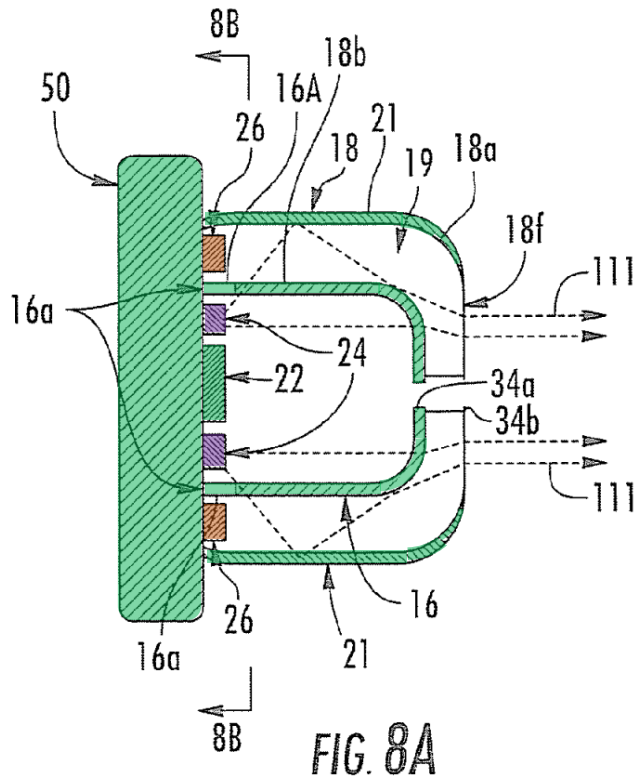
d) A POSITA Would Not Have Been Motivated to Implement LeBoeuf's Alleged Arc Arrangement in Lisogurski to Meet the Arc Limitation

274. As explained above, for the arc limitation in claim 6 that recites "wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs," Petitioners and Dr. Anthony argue that a POSITA would have applied LeBoeuf's alleged arc arrangement of optical detectors 26 shown by Figure 8B to arrange Lisogurski's LEDs and detectors to meet this limitation. Petition at 70-71, 68-69; Ex. 1003 at ¶¶ 311-14, 303-04. As also explained above, Petitioners and Dr. Anthony do not show that a POSITA would have been motivated to implement LeBoeuf's alleged arc arrangement in

Lisogurski. Further, a POSITA would not have been motivated to implement LeBoeuf's alleged arc arrangement in Lisogurski for at least the following reasons.

275. A POSITA would have understood that LeBoeuf is directed extensively to "earbud" devices that are specifically configured to be placed within a user's ear and to transmit light and sound into the ear canal. Ex. 1026 at Abstract, [0002], [0009], [0123], FIGS. 1-12B. In particular, the embodiment shown in LeBoeuf's Figures 8A-8B that Petitioners and Dr. Anthony rely upon for the arc limitation in claim 6 is a "light-guiding earbud." Ex. 1026 at ¶¶ [0048]-[0049], [0123].

276. A POSITA would have also understood that for the embodiment shown in LeBoeuf's Figures 8A-8B (annotated versions below), the alleged arc arrangement of optical detectors 26 (orange) that Petitioners and Dr. Anthony rely upon is premised on a corresponding arrangement of optical emitters 24 (purple) and other related components, including base 50, earbud housing 16 (including bottom portion 16a), cover 18 (including the various portions thereof), and speaker 22 (all green) as well as light guiding region 19:



Ex. 1026 at FIGS. 8A-8B (annotated), [0123]-[0124]. For example, in the embodiment of Figures 8A-8B, optical emitters 24 are positioned on base 50 around a centrally located speaker 22 and within earbud housing 16, and optical detectors 26 are positioned on base 50 outside of earbud housing 16 but inside cover 18, with emitters 24 and detectors 26 separated by light blocking region 16a, with emitters 24 and detectors 26 generally directed to cover end portion 18f, and with a light guiding region 19 defined by cover outer surface 18a with cladding material 21 and housing 16 in contact with cover inner surface 18b and serving as a cladding layer.

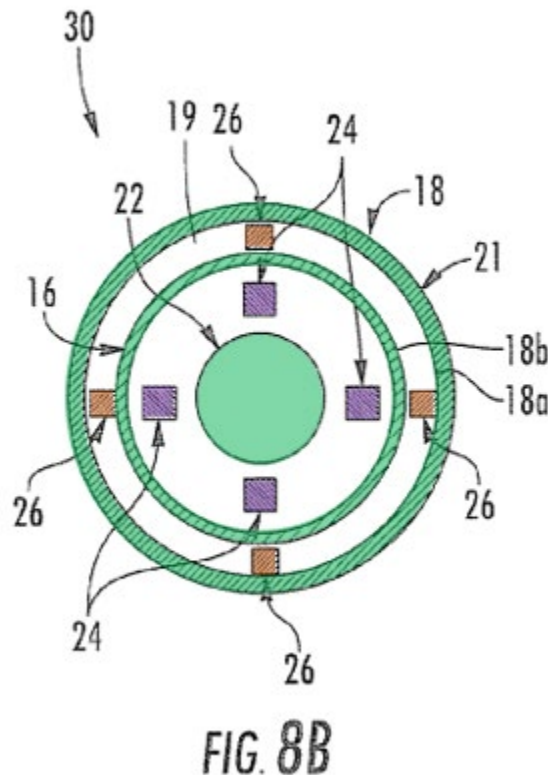
Ex. 1026 at FIGS. 8A-8B, [0123]-[0124].

277. A POSITA would have also understood that those other related components in Figures 8A-8B are earbud-specific components and that the configuration of components in Figures 8A-8B—including the alleged arc arrangement of detectors and the other related components on which that alleged arc arrangement is premised—is necessarily based on, and specific to, an earbud and the unique physical aspects of using a sound- and light-guiding earbud to deliver sound to and deliver/collect light to/from the ear canal. *See, e.g.*, Ex. 1026 at [0123] ("light guiding earbud 30"; "earbud housing 16 extending outwardly from the base 50 that is configured to be positioned within an ear"; "earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34a through which sound from the speaker 22 can pass"; "cover 18 includes at least one aperture 34b through which sound from the speaker 22 can pass"; "light guiding region 19"; "cover 18 ... serves as a light guide that delivers light from the optical emitters 24 into an ear canal ... through cover end portion 18f" and "also collects light through end portion 18f and delivers the collected light to the optical detectors 26").

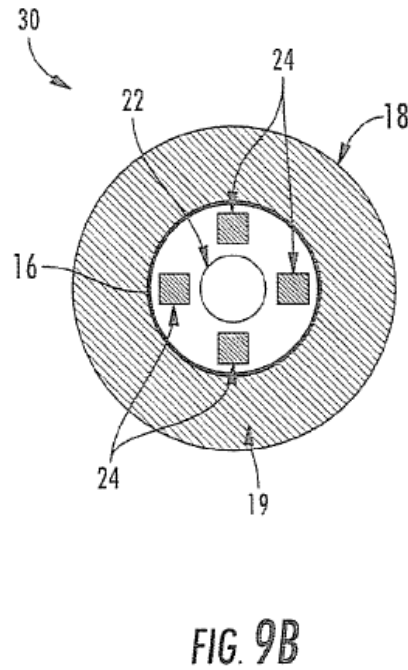
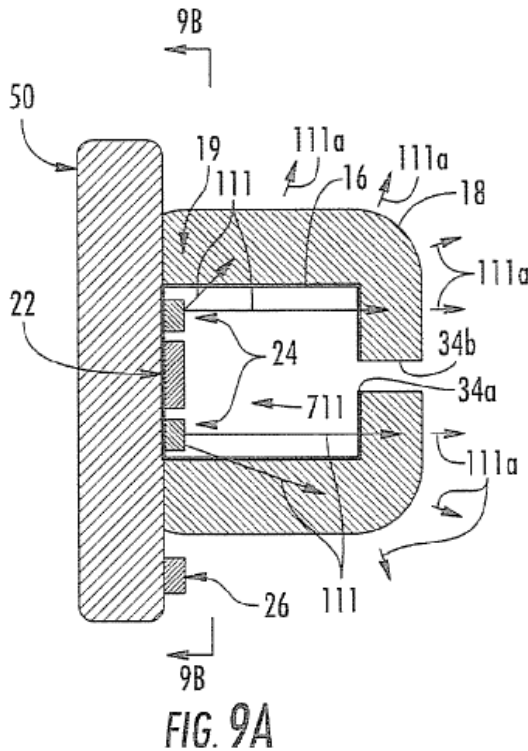
278. For example, the alleged arc arrangement that Petitioners and Dr. Anthony rely upon in LeBoeuf's Figure 8B is the positioning of detectors 26 relative to earbud-specific components, such as the positioning of detectors 26 and associated emitters 24 around "speaker 22" and around the circular bottom portions of "earbud housing 16" and "cover 18 that surrounds the earbud housing 16" and that

"serves as a light guide that delivers light from the optical emitters 24 into an ear canal." Ex. 1026 at [0123], FIGS. 8A-8B.

279. A POSITA would recognize that the generally cylindrical shapes of the earbud housing 16 and the cover 18 are dictated by the fact that they are designed to be placed in a user's ear. The fact that the emitters 24 and the detectors 26 are arranged in an "arc" in LeBoeuf is merely a result of the geometric constraints dictated by the fact that the earbud housing 16 and the cover 18 must be shaped to fit in an ear. Nothing in LeBeouf indicates to a POSITA that the arrangement of detectors and emitters in FIG. 8B has any advantage or benefit relative to other arrangements.



280. For example, LeBoeuf discloses an alternative embodiment in FIGS. 9A and 9B that includes four emitters 24 (as shown in FIG. 9B) and only one detector 26 (as shown in FIG. 9A). Ex. 1026 at FIGS. 9A-9B.



281. LeBoeuf does not disclose or suggest that the embodiment in FIG. 8B with four detectors arranged in an arc due to the geometry of the housing 16 and cover 18 is any more accurate than the embodiment in FIGS. 9A and 9B with only one detector that is not arranged along an arc. In fact, LeBouef indicates that the embodiment in FIGS. 9A and 9B is more accurate than the embodiment in FIGS. 8A and 8B because "the scattered light coming from the ear, measured by the optical

detector 26, is more indicative of blood flow changes within blood vessels and less indicative of mouth movements and body portion." Ex. 1026 at [0128].

282. A POSITA would have understood that Lisogurski, in contrast to LeBoeuf, does not teach that its sensor can be an earbud placed within an ear, let alone teach sound- and light-guiding earbud components such as those described above upon which LeBoeuf's alleged arc arrangement is premised. For example, Lisogurski does not disclose that its sensor can include a speaker or make sound. At most, a POSITA would have understood that Lisogurski only discloses that its sensor may be placed on an "earlobe" or "around or in front of the ear"—not **within** the ear like the relied-upon embodiment in Figure 8B of LeBoeuf. Ex. 1025 at 4:6-20; Ex. 1026 at [0123]. Lisogurski also does not teach that its sensor takes measurements from the ear canal like the relied-upon embodiment in LeBoeuf. Ex. 1026 at [0123]. A POSITA would have understood that Lisogurski only teaches a sensor that is placed on and takes measurements directly from an **external site** on a patient. Ex. 1025 at 4:6-20 (describing suitable sensor locations as a fingertip, toe, forehead, earlobe, foot, neck, wrist, thigh, ankle, and around or in front of the ear).

283. The Petition asserts that "[b]oth Lisogurski and LeBoeuf disclose physiological monitoring devices that can be worn on various parts of the body including the ear." Petition at 68 (citing Ex. 1025 at 4:6-20; Ex. 1026 at [0006], [0010]). This assertion is not made in the relevant paragraphs of Dr. Anthony's

declaration. Ex. 1003 at ¶¶ 303-04. Also, this assertion fails to recognize, as explained above, that (i) the alleged arc arrangement of detectors that Petitioners rely upon in LeBoeuf's Figure 8B is premised on other earbud-specific components, (ii) the configuration of components in LeBoeuf's Figure 8B, including the alleged arc arrangement and related components, is specific to an earbud, and (iii) Lisogurski does not teach that its sensor can be an earbud. Ex. 1025 at 4:6-20; Ex. 1026 at [0123]. The portions of Lisogurski and LeBoeuf that Petitioners cite for their assertion support this distinction. Ex. 1025 at 4:6-20 (disclosing at most that the sensor can be placed on an "earlobe" or "around or in front of the ear," but not in the ear); Ex. 1026 at [0006] ("earbud"), [0010] ("Light directed into the ear").

284. Because Lisogurski's sensor does not include the related components upon which LeBoeuf's alleged arc arrangement of detectors in Figures 8A-8B is premised, as explained above, and Petitioners and Dr. Anthony do not argue that Lisogurski would have been modified to include those related components, a POSITA would not have been motivated to implement LeBoeuf's alleged arc arrangement in Lisogurski nor capable of doing so. Ex. 1026 at FIGS. 8A-8B, [0123]-[0124].

285. Also, because Lisogurski does not teach or suggest that its sensor could be an earbud or placed within the ear, for example, to take measurements from the ear canal, a POSITA would not have modified Lisogurski's sensor based on

LeBoeuf's alleged arc arrangement of detectors, which is premised on related earbud-specific components and is part of an earbud-specific configuration, as explained above. Ex. 1026 at FIGS. 8A-8B, [0123]-[0124].

286. Petitioners and Dr. Anthony refer to Lisogurski's disclosure "that '[a]ny suitable configuration of light source 316 and detector 318 may be used,' and that 'sensor unit 312 may include multiple light sources and detectors, which may be spaced apart.'" Petition at 68 (quoting Ex. 1025 at 17:42-45); Ex. 1003 at ¶ 303 (same). But a POSITA would not have understood that the alleged arc arrangement in LeBoeuf's Figure 8B would be a suitable configuration for Lisogurski for the reasons explained herein, including that LeBoeuf's alleged arc arrangement is part of an earbud-specific embodiment, whereas Lisogurski is directed to a non-earbud sensor. Ex. 1026 at [0123]; Ex. 1025 at 4:6-20.

287. In addition to LeBoeuf's earbud embodiment shown in Figures 8A-8B that Petitioners and Dr. Anthony rely upon, LeBeouf also discloses non-earbud monitoring devices that "may ... be attached to earlobes, fingers, toes, other digits, etc.," such as monitoring device 70 shown in LeBoeuf's Figures 22A-22B that is "configured to fit over a finger" or monitoring device 70' in Figure 23 that is "configured to be attached to a body of a subject as a bandage." Ex. 1026 at [0070]-[0072], FIGS. 22A-23, [0157]-[0160], [0164]-[0165]. LeBoeuf's alleged arc arrangement that Petitioners and Dr. Anthony rely upon from the earbud

embodiment in Figure 8B, in which detectors 26 and associated emitters 24 are positioned around speaker 22 in earbud 30, is not included in the non-earbud devices 70 and 70' in Figures 22A-23, which each include only one optical emitter 24, detector 26, and noise detector 26'. Ex. 1026 at FIG. 8B, [0123], FIGS. 22A-23, [0157]-[0160], [0164]-[0165]. A POSITA would have understood that this difference between the earbud and non-earbud embodiments in LeBoeuf further shows that the configuration in LeBoeuf's Figure 8B, including the alleged arrangement, is specific to an earbud due to its unique sound application.

288. A POSITA reviewing Lisogurski and LeBoeuf would have understood that Lisogurski's sensor is comparable, at most, to LeBoeuf's non-earbud embodiments in Figures 22b-23, not the earbud embodiment in Figure 8B. Ex. 1025 at 4:6-20 (fingertip, toe, earlobe, and body for Lisogurski); Ex. 1026 at [0157] (fingers, toes, and earlobes for LeBoeuf's embodiment in FIGS. 22A-22B), [0164] (body for LeBoeuf's embodiment in FIG. 23).

2. Dependent Claim 7

289. I disagree with Petitioners and Dr. Anthony's assertion that claim 7 is obvious over Lisogurski and LeBoeuf.

290. Claim 7 depends from both claims 1 and 6, as claim 7 depends from claim 6 that depends from independent claim 1. For claim 7 here in Ground 3, Petitioners and Dr. Anthony rely on their analysis of claim 7 in Ground 1 and do not

address any of the deficiencies regarding Lisogurski in relation to claim 1 or the deficiencies regarding Lisogurski and LeBoeuf in relation to claim 6. Petition at 71-72; Ex. 1003 at ¶¶ 317-19. Also, Petitioners and Dr. Anthony's analysis of claim 7 does not rely on LeBoeuf to cure the deficiencies regarding Lisogurski in relation to claims 1. Petition at 71-72; Ex. 1003 at ¶¶ 317-19.

291. Therefore, Lisogurski and LeBoeuf do not render obvious claim 7 for at least the same reasons explained in Section X.A.1 above with respect to independent claim 1 and in Section X.C.1 above with respect to claim 6.

D. Ground 4: Obviousness Based on Lisogurski, Tran, and LeBoeuf (Claims 6-7)

292. I understand that Petitioners and Dr. Anthony argue for Ground 4 that claims 6-7 of the '475 Patent are obvious over Lisogurski, Tran, and LeBoeuf. Petition at 8; Ex. 1003 at ¶ 70; *see also* Petition at 66-72; Ex. 1003 at ¶¶ 300-19. I disagree for at least the reasons provided below.

1. Dependent Claim 6

293. I disagree with Petitioners and Dr. Anthony's assertion that claim 6 is obvious over Lisogurski, Tran, and LeBoeuf.

294. Claim 6 depends from independent claim 1. Petitioners and Dr. Anthony's analysis of claim 6 focuses on the additional limitations of claim 6 and does not address any of the deficiencies regarding Lisogurski in relation to claim 1. Petition at 70-71; Ex. 1003 at ¶¶ 308-16. Petitioners and Dr. Anthony's analysis of

claim 6 does not rely on Tran or LeBoeuf to cure the deficiencies regarding Lisogurski in relation to claim 1. Petition at 70-71; Ex. 1003 at ¶¶ 308-16.

295. Therefore, Lisogurski, Tran, and LeBoeuf do not render obvious claim 6 for at least the same reasons explained in Section X.A.1 above with respect to independent claim 1, and in Section X.A.2 above with respect to claim 6.

296. Additionally, I understand that Petitioners and Dr. Anthony's analysis of claim 6 here for Ground 4 (involving Lisogurski, Tran, and LeBoeuf) is the same as their analysis of claim 6 for Ground 3 (involving Lisogurski and LeBoeuf). Petition at 70-71; Ex. 1003 at ¶¶ 308-16. Petitioners and Dr. Anthony's analysis of claim 6 for Grounds 3-4 does not rely upon Tran. Petition at 70-71; Ex. 1003 at ¶¶ 308-16.

297. Therefore, Lisogurski Tran, and LeBoeuf do not teach or render obvious claim 6 here in Ground 4 for at least the same reasons explained in Section X.C.1 above with respect to claim 6 in Ground 3.

2. Dependent Claim 7

298. I disagree with Petitioners and Dr. Anthony's assertion that claim 7 is obvious over Lisogurski, Tran, and LeBoeuf.

299. Claim 7 depends from both claims 1 and 6, as claim 7 depends from claim 6 that depends from independent claim 1. For claim 7 here in Ground 4, Petitioners and Dr. Anthony rely on their analysis of claim 7 in Ground 2 and do not

address any of the deficiencies regarding Lisogurski in relation to claim 1 or the deficiencies regarding Lisogurski, Tran, and LeBoeuf in relation to claim 6. Petition at 71-72; Ex. 1003 at ¶¶ 317-19. Also, Petitioners and Dr. Anthony's analysis of claim 7 does not rely on Tran or LeBoeuf to cure the deficiencies regarding Lisogurski in relation to claims 1. Petition at 71-72; Ex. 1003 at ¶¶ 317-19.

300. Therefore, Lisogurski, Tran, and LeBoeuf do not render obvious claim 7 for at least the same reasons explained in Section X.A.1 above with respect to independent claim 1 and in Section X.D.1 above with respect to claim 6.

E. Ground 5: Obviousness Based on Lisogurski and Carlson (Claims 1, 6-8, and 11-13)

301. Petitioners and Dr. Anthony argue for Ground 5 that claims 1, 6-8, and 11-13 of the '475 Patent are obvious over Lisogurski and Carlson. Petition at 8; Ex. 1003 at ¶ 70; *see also* Petition at 72-76; Ex. 1003 at ¶¶ 320-36. I disagree for at least the reasons provided below.

302. Ground 5 is similar to Ground 1 except that Petitioners and Dr. Anthony argue the combination of Lisogurski (the only asserted reference in Ground 1) with Carlson for Ground 5. Petition at 8; Ex. 1003 at ¶ 70. Also, the only claim limitations addressed for Grounds 5-8 are limitations [1.e], [1.f], [8.b], and [8.d]. Petition at 72-76; Ex. 1003 at ¶¶ 320-36. Petitioners and Dr. Anthony's analysis for Ground 5 does not address any of the deficiencies regarding Lisogurski explained

above for Ground 1, including in relation to limitations [1.n] and [8.g], or rely upon Carlson to cure those deficiencies. *See* Petition at 72-76; Ex. 1003 at ¶¶ 320-36.

303. Therefore, Lisogurski and Carlson do not render obvious claims 1, 6-8, and 11-13 for at least the same reasons explained above with respect to Ground 1.

F. Ground 6: Obviousness Based on Lisogurski, Tran, and Carlson (Claims 5 and 7)

304. Petitioners and Dr. Anthony argue for Ground 6 that claims 5 and 7 of the '475 Patent are obvious over Lisogurski, Tran, and Carlson. Petition at 8; Ex. 1003 at ¶ 70; *see also* Petition at 72-76; Ex. 1003 at ¶¶ 320-36. I disagree for at least the reasons provided below.

305. Ground 6 is similar to Ground 2 except that Petitioners and Dr. Anthony argue the combination of Lisogurski and Tran (the only asserted references in Ground 2) with Carlson for Ground 6. Petition at 8; Ex. 1003 at ¶ 70. Also, the only claim limitations addressed for Grounds 5-8 are limitations [1.e], [1.f], [8.b], and [8.d]. Petition at 72-76; Ex. 1003 at ¶¶ 320-36. Petitioners and Dr. Anthony's analysis for Ground 6 does not address any of the deficiencies regarding Lisogurski and Tran explained above for Ground 2, including in relation to claim 5, or rely upon Carlson to cure those deficiencies. *See* Petition at 72-76; Ex. 1003 at ¶¶ 320-36.

306. Therefore, Lisogurski, Tran, and Carlson do not render obvious claims 5 and 7 for at least the same reasons explained above with respect to Ground 2.

G. Ground 7: Obviousness Based on Lisogurski, LeBoeuf, and Carlson (Claims 6-7)

307. Petitioners and Dr. Anthony argue for Ground 7 that claims 6-7 of the '475 Patent are obvious over Lisogurski, LeBoeuf, and Carlson. Petition at 8; Ex. 1003 at ¶ 70; *see also* Petition at 72-76; Ex. 1003 at ¶¶ 320-36. I disagree for at least the reasons provided below.

308. Ground 7 is similar to Ground 3 except that Petitioners and Dr. Anthony argue the combination of Lisogurski and LeBoeuf (the only asserted references in Ground 3) with Carlson for Ground 7. Petition at 8; Ex. 1003 at ¶ 70. Also, the only claim limitations addressed for Grounds 5-8 are limitations [1.e], [1.f], [8.b], and [8.d]. Petition at 72-76; Ex. 1003 at ¶¶ 320-36. Petitioners and Dr. Anthony's analysis for Ground 7 does not address any of the deficiencies regarding Lisogurski and LeBoeuf explained above for Ground 3, including in relation to claim 6, or rely upon Carlson to cure those deficiencies. *See* Petition at 72-76; Ex. 1003 at ¶¶ 320-36.

309. Therefore, Lisogurski, LeBoeuf, and Carlson do not render obvious claims 6- 7 for at least the same reasons explained above with respect to Ground 3.

H. Ground 8: Obviousness Based on Lisogurski, Tran, LeBoeuf, and Carlson (Claims 6-7)

310. Petitioners and Dr. Anthony argue for Ground 8 that claims 6-7 of the '475 Patent are obvious over Lisogurski, Tran, LeBoeuf, and Carlson. Petition at 8;

Ex. 1003 at ¶ 70; *see also* Petition at 72-76; Ex. 1003 at ¶¶ 320-36. I disagree for at least the reasons provided below.

311. Ground 8 is similar to Ground 4 except that Petitioners and Dr. Anthony argue the combination of Lisogurski, Tran, and LeBoeuf (the only asserted references in Ground 4) with Carlson for Ground 8. Petition at 8; Ex. 1003 at ¶ 70. Also, the only claim limitations addressed for Grounds 5-8 are limitations [1.e], [1.f], [8.b], and [8.d]. Petition at 72-76; Ex. 1003 at ¶¶ 320-36. Petitioners and Dr. Anthony's analysis for Ground 8 does not address any of the deficiencies regarding Lisogurski, Tran, and LeBoeuf explained above for Ground 4 or rely upon Carlson to cure those deficiencies. *See* Petition at 72-76; Ex. 1003 at ¶¶ 320-36.

312. Therefore, Lisogurski, Tran, LeBoeuf, and Carlson do not render obvious claims 5 and 7 for at least the same reasons explained above with respect to Ground 4.

I. Secondary Considerations of Non-Obviousness

313. I understand that the law recognizes the importance of certain objective indicia, commonly referred to as secondary considerations of non-obviousness, as an important part of the obviousness inquiry under 35 U.S.C. § 103. It is my understanding, that these secondary considerations include, among other things, commercial success of products practicing the claimed inventions, long-felt but unsolved need in the art, failure of others to arrive at the claimed solutions, industry

praise and recognition, copying by competitors, licensing activity, and unexpected results. It is my understanding that evidence of secondary considerations must always when present be considered en route to a determination of obviousness and that such evidence may often be the most probative and cogent evidence in the record.

314. It is my understanding that these secondary considerations serve as a critical check against the hindsight bias that inevitably accompanies any post-hoc reconstruction of the inventive process. I understand that secondary considerations serve to resist the temptation to read into the prior art the teachings of the invention in issue. I also understand that secondary considerations may often establish that an invention appearing to have been obvious in light of the prior art was not.

315. Non-obviousness of the '475 Patent is shown by evidence of a long-felt need in the industry that went unmet until the patented inventions provided a solution, as well as evidence that members in the industry, such as Samsung, responded to the '475 Patent's innovations by copying the patented technology rather than designing around it. This evidence, viewed together, helps to validate and confirm my opinions that the claimed inventions represented a meaningful advance over the prior art, not merely an obvious combination of known elements.

1. Copying

316. For the reasons set forth below, evidence demonstrates a pattern in which Samsung was directly exposed to the specific patented technologies disclosed and claimed in the '475 Patent through a series of in-person meetings, virtual conferences, and detailed presentations by Dr. Islam. Ex. 2100 at ¶¶ 7-21. Samsung subsequently implemented those teachings in its Accused Products (I refer herein to Samsung's products shown in Exhibit 2116 as the "Accused Products.")

a) Dr. Islam's Meetings with Samsung and Disclosure of Omni MedSci's Patented Technology

(1)

317.

318.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

319. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

320. [REDACTED]

[REDACTED]

[REDACTED]

321.

[REDACTED]

(2)

[REDACTED]

322.

[REDACTED]

323.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

(3)

324.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

(4)

[REDACTED]

325.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

(5)

[REDACTED]

326.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

**b) The Specific Technology Shared by Dr. Islam
Corresponds Directly to the Patented Features Found
in Samsung's Accused Products**

327. The presentations and materials shared by Dr. Islam with Samsung did not describe mere general information. The slide decks and materials shared with Samsung specifically identified multiple Omni MedSci patents and pending applications, and described the precise techniques for improving signal-to-noise

ratio that are disclosed and claimed in those patents. *See* Ex. 2103; Ex. 2106; Ex. 2100 at ¶¶ 13, 16, 30; *see also* Ex. 2113; Ex. 2114.

328. For example, the presentation materials shared with Samsung specifically identified the following proprietary techniques:

- [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
- [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

- [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
- [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
- [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

See Ex. 2100 at ¶¶ 13, 16, 30; Ex. 2103; Ex. 2106. I have reviewed the claim chart in Exhibit 2116 and agree with the analysis therein.

329. The presentation materials also explicitly identified Omni MedSci's patents by number, including the related '533 Patent and related patent applications (e.g., U.S. Pat. Pub. Nos. 2017/0071474 and 2016/0327476), and described their

coverage of these specific techniques. Ex. 2106 at OMS_SAM0031857-858; Ex. 2100 at ¶¶ 15-16. Dr. Islam further offered that “we could help Samsung incorporate these techniques with a strong patent protection / barrier to entry for others.” Ex. 2100 at ¶ 16; Ex. 2106 at OMS_SAM0031856.

330. Without a license or approval from Omni Med Sci, Samsung took the information it learned from Dr. Islam regarding the technologies disclosed and claimed in the '475 Patent and implemented those teachings into its own Accused Products. Dr. Islam confirmed that Samsung never ended up collaborating with Omni MedSci. Ex. 2100 at ¶ 18.

331. Samsung's Accused Products practice the challenged claims of the '475 Patent by incorporating the same suite of SNR-improvement techniques that Dr. Islam disclosed to Samsung, including: (1) increasing LED light intensity to improve SNR; (2) ambient light cancellation through change detection (differencing signals with LEDs on and off); (3) spatially separated detectors; and (4) synchronization of the detection system with the light source. Ex. 2116; Ex. 2100 at ¶ 30.

332. These are not generic or commonplace features. The inventive contribution of the '475 Patent lies in this coordinated suite of hardware and signal-processing techniques to overcome the challenges of improving the signal-to-noise ratio of physiological measurements obtained from wearable devices during real-world conditions. These techniques address the challenge of accurately measuring

physiological parameters using optical wearable devices during physical activity, when numerous factors degrade measurement accuracy.

c) Conclusion

333. The evidence establishes a nexus between Samsung's exposure to Omni MedSci's patented technology and the implementation of those same technologies in Samsung's products. From 2017 through 2023, Dr. Islam shared detailed information with Samsung personnel at multiple levels of the organization, from the President of Samsung SDS, to senior vice presidents at Samsung Electronics, to senior managers and engineers at Samsung subsidiaries, specifically identifying the related '533 Patent and other related patents or patent applications and the techniques they disclosed for improving the signal-to-noise ratio of wearable physiological measurement devices. The copying factor of secondary considerations weighs strongly in favor of the non-obviousness of the challenged claims.

2. Long-Felt but Unsolved Need: Motion Artifacts and Ambient Light Degradation of PPG Signals in Wearable Devices

334. Non-obviousness is further supported by the well documented, long felt need in the wearable health monitoring industry for techniques that would enable accurate photoplethysmographic (PPG) measurement of physiological parameters, such as heart rate, heart rate variability, and blood oxygen saturation, during conditions involving user motion and exposure to ambient light.

335. The prior art and industry evidence demonstrate that, prior to the '475 Patent, the degradation of PPG signal quality caused by motion artifacts and ambient light interference was a persistent, widely recognized problem that the field had been unable to solve by conventional means. Instead, the prevailing approaches required patients to remain still, confined measurements to controlled clinical environments, or relied on filtering and software algorithms that were themselves acknowledged as insufficient.

336. The '475 Patent addressed this long felt need by disclosing a suite of integrated hardware and signal processing techniques, including ambient light cancellation through change detection schemes, synchronization of LED transmitters and receivers, and dynamic adjustment of LED light intensity, that collectively enabled sufficiently accurate physiological measurements during the daytime and during exercise, conditions under which prior devices had consistently failed.

a) The Recognized Problem: Motion Artifacts Degrade PPG Signal Quality

337. The prior art documents produced by the Petitioners in related district court litigation confirm that motion artifacts were a pervasive and intractable obstacle to accurate PPG-based physiological measurement in wearable devices. Ex. 2100 at ¶¶ 22-23. For example, U.S. Pat. No. 5,632,272 to Diab et al. and assigned

to Masimo Corp. explains the fundamental challenge: “When the patient moves, this causes perturbation such as changing optical pathlength due to movement of background fluids.... Therefore, the measured signal becomes erratic. Erratic motion induced noise typically cannot be predetermined and/or subtracted from the measured signal via traditional filtering techniques.” Ex. 2108 at 34:1-7; Ex. 2100 at ¶ 22. This candid admission, that motion-induced noise “typically cannot be predetermined and/or subtracted” through traditional filtering, illustrates that the problem was not merely one of optimization but of fundamental technical inadequacy. The prior art filtering approaches simply could not handle the unpredictable, non-periodic nature of motion artifacts in real-world use.

338. U.S. Patent No. 7,738,935 to Turcott and assigned to Pacesetter, Inc. corroborates the severity and pervasiveness of this challenge: “A problem with current methods and devices for performing pulse oximetry is that they are acutely sensitive to sensor and/or tissue motion. Even rather subtle motion can (and often do) swamp the detected optical signals and render the oxygen saturation measurements unusable. For example, with pulse oximetry devices that measure blood volume changes in a fingertip or earlobe, such subtle motion may be caused by a patient’s slight movement of their finger or head.” Ex. 2109 at 3:24-34; Ex. 2100 at ¶ 23. The use of the word “swamp” is telling, indicating that even minor,

involuntary movements were sufficient to overwhelm the PPG signal entirely, rendering the resulting measurements not merely degraded but “unusable.”

b) The Inadequacy of Pre-Existing Solutions

339. Prior to the techniques disclosed in the '475 Patent, the industry's response to the motion artifact problem fell into three general categories, each of which was widely recognized as inadequate for enabling the kind of continuous, real world health monitoring that consumer expect from their modern wearable devices. Ex. 2100 at ¶¶ 24-28.

340. *First*, requiring the patient to remain still. Ex. 2100 at ¶ 25. The most common workaround was simply to restrict measurements to periods when the user was immobile. For example, U.S. Pat. No. 6,126,595 to Amano et al. and assigned to Seiko Epson Corp. is unusually explicit on this point, commenting that “when, for example, the test subject is waving his arm, the blood pulse wave cannot be measured. Accordingly, measurements obviously cannot be made during sports activity, while activities such as walking inside a room or outside are also not suitable for measurements.” Ex. 2110 at 61:38-43. The patent goes on to explain that the user was instructed to “sit in the chair... and place the arm with the watch on the desk, taking care not to move his hand.” *Id.* at 61:44-47. This was not a temporary limitation; it was the design specification. If the user was not in “a state of repose,” the device would notify the user via its output and would only proceed with

measurements “after confirming that the user is in a suitable state of repose.” *Id.* at 68:39-49. The entire measurement paradigm was predicated on the assumption that motion and accurate measurement were fundamentally incompatible.

341. **Second**, conducting testing in controlled environments. Ex. 2100 at ¶ 26. A closely related approach was to confirm measurements to clinical or controlled settings. Prior to the claimed inventions of the '475 Patent, devices were largely confined to controlled and static environments, like doctor's offices and laboratories. The non-invasive consumer wearable devices providing consumers with 24/7 physiological measurements were simply not available. The experimental protocol explained in the Seiko Epson '595 patent exemplifies this approach, explaining that “13 healthy male subjects, aged 21 ± 9 years, were required to carry out identical activities in the same facility for a 36-hour period spanning 2 days. Ambient temperature was maintained in the range of 24.0° to 24.5° C., with humidity held in the range of 40 to 50%.... The subjects were required to assume a state of repose 15 minutes prior to making any of the measurements. While measurements were being taken, the subjects were required to breath at a regular rate in time with a 0.25 Hz metronome.” Ex. 2110 at 16:1-23. The need for such tightly controlled conditions underscores the fragility of PPG-based measurements in real world environments.

342. **Third**, implementing filtering and software algorithm techniques. Ex. 2100 at ¶ 26. The third approach, the use of adaptive filters, Kalman filters, or other

software-based motion compensation, was acknowledged as an improvement over mere stillness but was itself recognized as insufficient. U.S. Pat. Pub. No. 2014/0275854 filed by Fitbit, Inc. in 2014 discloses that “the raw heartbeat waveform signal measured by a PPG sensor may be improved by using one or more algorithms to remove motion artifacts... The goal of such algorithms is to remove components of the PPG signal attributable to movement (movement artifacts) using the movement signal captured from the other sensors as a guide.” Ex. 2111 at ¶ [0136]. However, these algorithms were explicitly designed only for the case where “the user’s motion is periodic,” that is, repetitive activities like walking or running, and even then, required multiple passes of adaptive filtering to produce acceptable results. *Id.* at ¶ [0147]. The ’272 Patent assigned to Masimo Corp. confirms, “erratic motion induced noise typically cannot be predetermined and/or subtracted from the measured signal via traditional filtering techniques.” Ex. 2108 at 34:1-7.

343. The GE Dash 2000 Patient Monitor manual provides a clinical perspective on the same limitations: “Motion artifact occurs with excessive motion of the probe, the cable leading to the probe or the cable/probe junction... The main problem motion artifact can cause is erroneous SPO2 readings. Motion artifact can be reduced, if not eliminated, by selecting a ‘quieter’ site on the patient.” Ex. 2112 at DEFS-PA_0007696; Ex. 2100 at ¶ 28. The manual’s proposed solution, choosing a “quieter” body site or taping cables to the patient’s hand is a mechanical

workaround, not a technological solution, and it confirms that even in clinical grade devices, the engineering community had not solved the underlying problem.

c) The Ambient Light Problem Compounded the Challenge

344. Ambient light interference posed an additional and compounding obstacle to accurate PPG measurements, particularly during the daytime and outdoor settings where wearable health monitoring is most needed. The '854 application filed by Fitbit in 2014 acknowledges that “[a]mbient light and skin color may make it difficult to extract a user’s heart rate from a PPG signal” and describes a technique for reducing the effect of ambient light by “subtracting a value of the received detected light signal when the PPG light source is off from the value of the received detected light signal when the PPG light source is on.” Ex. 2111 at ¶ [0194] ; Ex. 2100 at ¶ 29.

345. The combined challenge of ambient light and motion was precisely what the '475 Patent was designed to address. Ex. 2100 at ¶ 30. Earlier wearable devices could reliably capture physiological measurements only under ideal conditions, such as during motionless sleep at night, relying on low-power light sources and modest sampling rates. However, obtaining accurate measurements became significantly more difficult during daytime use and periods of physical activity such as exercise, which are precisely the scenarios in which such data is

most valuable to the wearer. Exposure to ambient daylight and bodily movement during activities like exercise degraded the accuracy of physiological readings, often pushing them below acceptable accuracy levels.

d) The Academic Literature Confirms the Unresolved Nature of the Problem

346. Academic sources confirm that the motion artifact problem remained unsolved during the relevant time period. A 2012 paper titled “A review of wearable sensors and systems with application in rehabilitation” by Patel et al. identifies motion artifacts in wearable PPG sensors as an open problem: “Although systems of this type have shown promising results, additional work appears to be necessary to achieve motion artifact reduction. Proper attenuation of motion artifacts is essential to the deployment of wearable sensors.” Ex. 2115 at OURA_0026873. The authors further observe that “[s]ome of the problems due to motion artifacts could be minimized by integrating sensors into tight fitting garments,” but emphasize that “further advances in signal processing techniques to mitigate motion artifacts are needed.” *Id.* The use of the phrase “additional work appears to be necessary” and “further advances... are needed” is the language of an unsolved problem existing in 2012 when this paper was published, not one for which the prior art had already provided obvious solutions.

e) The Industry's Continued Failure to Solve the Problem

347. Major companies in the industry continued to struggle with solving the SNR and motion artifact problem by 2016-2017. Ex. 2100 at ¶¶ 31-33. For example, in Dr. Islam's slides presented to Samsung in 2017, he included studies documenting the problem and the failure of industry participants such as Samsung, Fitbit, and Microsoft to solve it. Ex. 2100 at ¶¶ 31, 33; Ex. 2103 at OMS_SAM0031786; Ex. 2106 at OMS_SAM0031851; Ex. 2113; Ex. 2114. As another example, Apple was investigating solutions to the problem up through at least 2017, including meeting with Dr. Islam. Ex. 2100 at ¶ 32.

f) The Challenged Patent Solves the Problem

348. The claimed inventions of the '475 Patent solve this long-felt and unresolved need by combining an integrated suite of hardware and SNR-improvement techniques—as I discuss above in Section X.I.1.b with respect to Samsung's Accused Products copying the claimed invention—including (1) increasing LED light intensity to improve SNR; (2) ambient light cancellation through change detection (differencing signals with LEDs on and off); (3) spatially separated detectors; and (4) synchronization of the detection system with the light source. Ex. 2100 at ¶ 30; *supra*, § X.I.1.b. The claimed inventions thereby enabled accurate physiological measurements despite problems of ambient light and motion artifacts. Ex. 2100 at ¶ 30.

g) Conclusion

349. The evidence from the prior art patents, industry documents, and academic literature demonstrates a clear and well documented long felt need for techniques enabling accurate PPG based physiological measurement during motion and under varying ambient light conditions. The pre-existing approaches, requiring the patient to remain still, confining measurements to controlled environments, and applying filtering algorithms, were universally acknowledged as inadequate for the demands of real world wearable health monitoring. Ex. 2100 at ¶¶ 22-33. The '475 Patent disclosed an integrated suite of techniques that collectively addressed this long felt need, enabling, for the first time, the sufficiently accurate measurement of heart rate, SpO₂, and other physiological parameters during the daytime and during exercise. Ex. 2100 at ¶ 30.

350. For example, the following claimed features address the long-felt needs that others failed to solve:

- “the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity” (claim 1);
- “the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off, generate a second signal responsive to light received while at least one of the light emitting

diodes is on, and increase the signal-to-noise ratio by comparing the first signal and the second signal”; “a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio; (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio” (claims 1, 8);

- “wherein the detection system comprises a plurality of detectors that are spatially separated from each other”; “wherein the detection system comprises the plurality of detectors arranged along an arc” (claims 1, 6);
- “wherein the detection system is configured to be synchronized to the light source” (claim 1).

XI. CONCLUSION

351. In my opinion, the challenged claims of the '475 Patent would not have been obvious to a POSITA as of the priority date of the '475 Patent in view of the asserted references that Petitioners and Dr. Anthony rely upon in Grounds 1-8.

Accordingly, it is my opinion that all challenged claims of the '475 Patent are patentable over the asserted references.

352. I reserve the right to modify or supplement my opinions, if necessary, based on further review and analysis of the evidence in this case, including review and analysis of information that may be provided to me subsequent to the date of this declaration.

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

Date: May 7, 2026



Igor Efimov, Ph. D.