

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

WHOOP, INC.

Petitioner,

v.

OMNI MEDSCI, INC.,

Patent Owner.

U.S. Patent No. 11,160,455

Case No. IPR2025-01585

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. 11,160,455 (“the ’455 Patent”) (Ex. 1001) in connection with an *inter partes* review (“IPR”) petition filed by WHOOP, Inc. (“Petitioner”).

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 ’455 Patent against Whoop, Inc., in a related matter currently pending in the United States District Court for the District of Delaware (the “Delaware Case”).

5. I also understand that Omni is asserting the ’455 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”).

6. I further understand that the Defendants in the Texas Case have filed an IPR petition challenging the ’455 Patent in IPR2025-01252 (“the Samsung ’455

IPR”). I have offered certain opinions regarding the ’455 Patent and the grounds in the Samsung ’455 IPR in a declaration dated November 12, 2025 (Ex. 2031 in Samsung ’455 IPR). Ex. 2055. Certain content in this declaration may overlap with content in my declaration in the Samsung ’455 IPR. For example, the Overview of the ’455 Patent (Section V in this declaration) is the same or substantially the same in both declarations.

7. In this declaration, I offer opinions relating to the ’455 Patent, claim construction, the references in the Petition, and the declaration of Petitioner’s expert Dr. Mercier. The substance and bases of my opinions appear below.

I. BACKGROUND AND QUALIFICATIONS

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

9. 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.

10. 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.

11. 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.

12. 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.

13. 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.

14. 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.

15. 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-Berlioz 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).

16. 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.

17. 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.

18. In 2021-2025, I served as the 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, medical devices, cardiac electrophysiology, signal processing, arrhythmia therapy, etc.

19. 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.

20. 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.

21. 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.

22. 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.

23. 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.

24. A more detailed listing of my credentials is set forth in my curriculum vitae (Ex. 2047).

II. MATERIALS CONSIDERED

25. 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 '455 Patent (Ex. 1001) and the '455 Patent's file history (Ex. 1002), and at least the following additional materials.

- Petition for *Inter Partes* Review of the '455 Patent (Paper 1) (“Petition”);

- Declaration of Patrick Mercier in Support of Petition for *Inter Partes* Review of U.S. Patent No. 11,160,455 (Ex. 1003);
- U.S. Patent No. 9,651,533 (Ex. 1004);
- U.S. Patent No. 10,517,484 (Ex. 1005);
- Docket Sheet, *Omni MedSci, Inc. v. WHOOP, Inc.*, No. 1:25-cv-00140 (D. Del.) (Ex. 1006);
- Docket Sheet, *Omni MedSci, Inc. v. Samsung Elecs., et al.*, No. 2:24-cv-01070 (E.D. Tex.) (Ex. 1007);
- *Apple Inc. v. Omni MedSci, Inc.*, IPR2019-00916, Paper No. 39 (PTAB Oct. 14, 2020) (Final Written Decision, '533 IPR) (Ex. 1008)
- *Omni MedSci, Inc. v. Apple Inc.*, No. 21-1229, 2022 WL 2062168 (Fed. Cir. Jun. 8, 2022) (Ex. 1009);
- *Apple Inc. v. Omni MedSci, Inc.*, IPR2021-00453, Patent Owner's Notice of Appeal (PTAB Apr. 11, 2025) (Ex. 1010);
- *Apple Inc. v. Omni MedSci, Inc.*, IPR2021-00453, Paper No. 22 (PTAB Aug. 3, 2022) (First Final Written Decision, '484 IPR) (Ex. 1011);
- *Apple Inc. v. Omni MedSci, Inc.*, No. 23-1034, 2024 WL 3084509 (Fed. Cir. Jun. 21, 2024) (First Federal Circuit Decision, '484 IPR) (Ex. 1012);

- *Apple Inc. v. Omni MedSci, Inc.*, IPR2021-00453, Paper No. 26 (PTAB Feb. 14, 2025) (Second Final Written Decision, '484 IPR) (Ex. 1013);
- Docket Sheet, *Omni MedSci, Inc. v. Apple Inc.*, No. 25-1646 (Fed. Cir.) (Docket Sheet, Second Federal Circuit Appeal, '484 IPR) (Ex. 1014);
- *Apple Inc. v. Omni MedSci, Inc.*, IPR2019-00916, Paper No. 1 (PTAB Apr. 10, 2019) (Petition, '533 IPR) (Ex. 1015);
- *Apple Inc. v. Omni MedSci, Inc.*, IPR2019-00916, Paper No. 16, (PTAB Oct. 18, 2019) (Institution Decision, '533 IPR) (Ex. 1017);
- *Apple Inc. v. Omni MedSci, Inc.*, IPR2019-00916, Paper No. 23 (PTAB Jan. 31, 2020) (Patent Owner Response) (Ex. 1018);
- *Apple Inc. v. Omni MedSci, Inc.*, IPR2021-00453, Paper No. 1, (PTAB Jan. 22, 2021) (Petition, '484 IPR) (Ex. 1021);
- *Apple Inc. v. Omni MedSci, Inc.*, IPR2021-00453, Paper No. 7 (PTAB Aug. 6, 2021) (Institution Decision, '484 IPR) (Ex. 1023);
- *Apple Inc. v. Omni MedSci, Inc.*, IPR2021-00453, Paper No. 10 (PTAB Nov. 12, 2021) (Patent Owner Response, '484 IPR) (Ex. 1024);
- U.S. Patent No. 9,241,676 (“Lisogurski”) (Ex. 1027);
- U.S. Patent App. Pub. No. 2005/0049468 (“Carlson”) (Ex. 1028);
- U.S. Patent No. 6,304,767 (“Soller”) (Ex. 1030);
- U.S. Patent No. 8,108,036 (“Tran”) (Ex. 1031);

- U.S. Patent Appl. Pub. No. 2012/0197093 (“Valencell-093”) (Ex. 1032);
- “The Biomedical Engineering Handbook,” by Joseph D. Bronzino (1995) (Ex. 1033);
- Patel, et al., A review of wearable sensors and systems with application rehabilitation, *Journal of Neuroengineering & Rehabilitation* (2012) (Ex. 1034);
- A. Omre, Bluetooth Low Energy: Wireless Connectivity for Medical Monitoring, *Journal of Diabetes Science & Technology* (Mar. 2010) (Ex. 1035);
- P. Baum, et al., Strategic Intelligence Monitor on Personal Health Systems, Phase 2: Market Developments - Remote Patient Monitoring and Treatment, *Telecare, Fitness/Wellness and mHealth, JRC Scientific and Policy Reports of European Commission* (2013) (Ex. 1036);
- M. Kranz, et al., The mobile fitness coach: Towards individualized skill assessment using personalized mobile devices, *Pervasive and Mobile Computing* (June 2012) (Ex. 1037);
- M. Swan, Senior Mania! The Internet of Things, Wearable Computing, Objective Metrics, and the Quantified Self 2.0, *Journal of Sensor and Actuator Networks* (2012) (Ex. 1038);

- “The Usage of Tablets in the HealthCare Industry,” by Rauf Adil (Aug. 2, 2012), available through the Internet Archive at <https://web.archive.org/web/20121014002306/https://www.healthcareitnews.com/blog/usage-tablets-healthcare-industry> (last accessed Sept. 4, 2025) (Ex. 1040);
- Deposition of Duncan Leo MacFarlane, Ph.D., P.E., *Apple Inc. v. Omni MedSci, Inc.*, IPR2019-00916 (PTAB April 16, 2020) (Ex. 1041);
- Curriculum Vitae of Patrick Mercier, PhD (Ex. 1042);
- Docket Sheet, *Omni MedSci, Inc. v. Apple Inc.*, No. 4:19-cv-05924 (N.D. Cal.) (Ex. 1043);
- Webster, J. G. (1997) *Design of Pulse Oximeters*, IOP Publishing (Ex. 1045);
- *Samsung Elecs. Co. et al. v. Omni MedSci, Inc.*, IPR2025-01250, Paper No. 1 (PTAB Aug. 5, 2025) (’533 IPR Petition) (Ex. 1050);
- *Samsung Elecs. Co. et al. v. Omni MedSci, Inc.*, IPR2025-01251, Paper No. 1 (PTAB Aug. 5, 2025) (’304 IPR Petition) (Ex. 1051);
- *Samsung Elecs. Co. et al. v. Omni MedSci, Inc.*, IPR2025-01252, Paper No. 1 (PTAB Aug. 5, 2025) (’455 IPR Petition) (Ex. 1052);
- *Samsung Elecs. Co. et al. v. Omni MedSci, Inc.*, IPR2025-01253, Paper No. 1 (PTAB Aug. 5, 2025) (’790 IPR Petition) (Ex. 1053);

- *Samsung Elecs. Co. et al. v. Omni MedSci, Inc.*, PGR2025-00064, Paper No. 1 (PTAB Aug. 5, 2025) ('790 PGR Petition) (Ex. 1054);
- *Samsung Elecs. Co. et al. v. Omni MedSci, Inc.*, IPR2025-01254, Paper No. 1 (PTAB Aug. 5, 2025) ('475 IPR Petition) (Ex. 1055);
- *Samsung Elecs. Co. et al. v. Omni MedSci, Inc.*, IPR2025-00063, Paper No. 1 (PTAB Aug. 5, 2025) ('475 PGR Petition) (Ex. 1056);
- U.S. Patent No. 10,874,304 (Ex. 1057);
- U.S. Patent No. 12,193,790 (Ex. 1059);
- U.S. Patent No. 12,268,475 (Ex. 1060)

26. 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.

27. 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

28. 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

29. 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.

30. 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.

31. 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

32. 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.

33. 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.

34. 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.

35. 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.

36. 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

37. 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.

38. 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

39. 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.

40. 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.

41. 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.

42. 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.

43. 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.

44. 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.

45. 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.

46. 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.

47. 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.

48. 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.

49. 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

50. 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

51. 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.

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

A person of ordinary skill in the art (“POSITA”) at the time of the alleged invention (December 2012) would have had good working knowledge of optical sensing techniques and their applications, and familiarity with optical system design and signal processing techniques. EX1003 ¶25. The POSITA would have an undergraduate degree in engineering (electrical, mechanical, biomedical, or optical) or a related field of study, along with relevant experience studying or developing physiological monitoring devices (e.g., non-invasive optical biosensors) in industry or academia. *Id.* Lack of professional experience can be remedied by additional education, and vice versa. *Id.*

Petition at 13; Ex. 1003 at ¶25.

53. For purposes of this declaration, I have applied the Petitioner's proposed definition in my analysis. I reserve the right to identify a differing level of skill in the art for the '455 Patent should an IPR be instituted.

54. 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 Petitioner has 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 '455 PATENT

55. The '455 Patent discloses, for example, systems for measuring physiological parameters and for use with a smartphone or tablet. Ex. 1001 at Abstract, 8:29-31. The '455 Patent discloses such systems, including a wearable device that includes a light source comprising a driver and a plurality of semiconductor sources that generate an output light that is delivered to tissue. Ex. 1001 at Abstract, 8:29-36. The '455 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, 8:39-47.

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

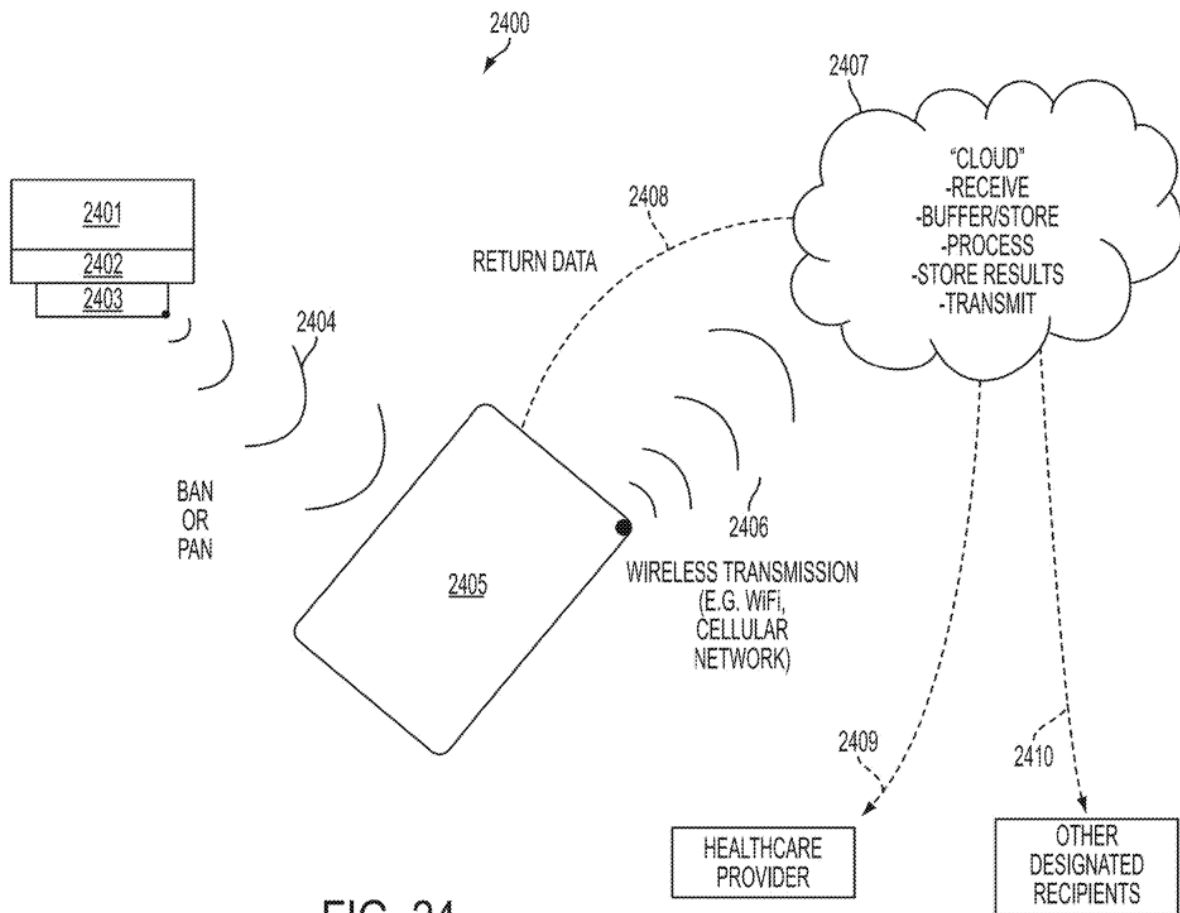


FIG. 24

Ex. 1001 at FIG. 24, 12:1-6. 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 36:18-56.

57. The '455 Patent discloses that the plurality of semiconductor sources and the plurality of detectors in the wearable device may be located on one or more arcs. Ex. 1001 at Abstract, 9:47-50. The '455 Patent also discloses that the wearable device may include a reflective surface to receive and redirect at least some of the

output optical light from the plurality of semiconductor sources. Ex. 1001 at 87:51-54, 88:64-67, 90:23-26.

58. Additionally, the '455 Patent discloses multiple techniques employed by the wearable measurement device that improve a signal-to-noise ratio of the signal. Ex. 1001 at 59:4-25. This results in a more accurate reading of the user's physiological parameters despite interference from spectral artifacts. Ex. 1001 at 2:66-3:40.

59. The '455 Patent includes 20 claims, and claims 1, 8, and 15 are independent claims. Ex. 1001 at 86:41-90:44.

VI. PROSECUTION HISTORY OF THE '455 PATENT

60. I have reviewed and analyzed the prosecution history of the '455 Patent. I understand that the '455 Patent issued from U.S. Patent Application No. 17/078,771, which was filed on October 23, 2020.

61. I understand that U.S. Patent Application No. 17/078,771 was a continuation of U.S. Patent Application No. 16/772,188, which was filed on December 20, 2019, and issued as U.S. Patent No. 10,820,807.

62. I understand that the '455 Patent claims priority to 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, Provisional Application No. 61/747,487, which was filed on Dec. 31, 2012 and drafted at least as early as Oct. 10, 2012, Provisional Application No. 61/747,477, which was filed on Dec. 31, 2012 and drafted at least as early as Dec. 24, 2012, and Provisional Application No. 61/754,698, which was filed on Jan. 21, 2013 and drafted at least as early as Aug. 10, 2012.

VII. CHALLENGED CLAIMS

63. I understand that the Petition challenges claims 1-20 (“the challenged claims”) of the ’455 Patent. Petition at 11. I understand that claims 1, 8, and 15 are independent claims. Ex. 1001 at 86:42-90:44. I further understand that dependent claims 2-7 depend (directly or indirectly) from independent claim 1, that dependent claims 9-14 depend (directly or indirectly) from independent claim 8, and that dependent claims 16-20 depend (directly or indirectly) from independent claim 15. Ex. 1001 at 86:42-90:44.

64. 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 84-90 (“Appendix A: Challenged Claim Listing”).

65. Independent claim 1 recites the following:

- 1[pre]** – A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:
- 1[a]** – a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, and including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;
 - 1[b]** – the wearable device comprising 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;
 - 1[c]** – the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source;
 - 1[d]** – 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 spatially separated detectors;
 - 1[e]** – the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;
 - 1[f]** – wherein the output signal is indicative of one or more of the physiological parameters;
 - 1[g]** – the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the semiconductor sources from an initial light intensity;
 - 1[h]** – the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off,
 - 1[i]** – generate a second signal responsive to light received while at least one of the semiconductor sources is on; and
 - 1[j]** – increase the signal-to-noise ratio by comparing the first signal and the second signal; and
 - 1[k]** – wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.

66. Dependent claim 2 depends from independent claim 1 and recites the following:

2 – The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.

67. Dependent claim 6 depends indirectly from dependent claim 2 and independent claim 1. Claim 6 recites the following:

6 – The system of claim 5, wherein the wearable device further comprises a reflective surface to receive and redirect at least some of the output optical light from the plurality of semiconductor sources.

68. Independent claim 8 recites the following:

8[pre] – A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:

8[a] – a wearable device adapted to be placed on a wrist or an ear of a user, including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;

8[b] – the wearable device comprising 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;

8[c] – the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source;

8[d] – 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 spatially separated detectors;

8[e] – the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch

- screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;
- 8[f]** – wherein the output signal is indicative of one or more of the physiological parameters;
- 8[g]** – the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of semiconductor sources from an initial light intensity; and
- 8[h]** – the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,
- 8[i]** – generate a second signal responsive to light received while at least one of the light emitting diodes is on, and
- 8[j]** – increase the signal-to-noise ratio by comparing the first signal and the second signal; and
- 8[k]** – wherein the plurality of semiconductor sources comprises six light emitting diodes.

69. Dependent claim 9 depends from independent claim 8 and recites the following:

- 9** – The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.

70. Dependent claim 13 depends indirectly from independent claim 8 and recites the following:

- 13** – The system of claim 12, wherein the wearable device further comprises a reflective surface positioned to receive and redirect at least some of the output optical light from the plurality of semiconductor sources.

71. Independent claim 15 recites the following:

- 15[pre]** – A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:
- 15[a]** – a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,

- including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;
- 15[b]** – the wearable device comprising 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;
- 15[c]** – the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source;
- 15[d]** – 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 spatially separated detectors;
- 15[e]** – the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;
- 15[f]** – wherein the output signal is indicative of one or more of the physiological parameters;
- 15[g]** – the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of semiconductor sources from an initial light intensity; and
- 15[h]** – the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,
- 15[i]** – generate a second signal responsive to light received while at least one of the light emitting diodes is on, and
- 15[j]** – increase the signal-to-noise ratio by comparing the first signal and the second signal;
- 15[k]** – wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and
- 15[l]** – wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.

72. Dependent claim 17 depends indirectly from independent claim 15 and recites the following:

17 – The system of claim 16, wherein the wearable device further comprises a reflective surface to receive and redirect at least some of the output optical light from the plurality of semiconductor sources.

VIII. CLAIM CONSTRUCTION

73. Petitioner contends that the terms in the challenged claims of the '455 Patent do not require construction. Petition at 11-12. Unless otherwise noted, I have applied the plain and ordinary meaning of those terms in the '455 Patent as they would be understood by a POSITA.

74. Independent claim 1 of the '455 Patent recites “a wearable device ... including a light source comprising a driver and a plurality of semiconductor sources, ... the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the semiconductor sources from an initial light intensity.” Ex. 1001 at 86:42-87:13. Dependent claim 7 recites “wherein the wearable device is further configured to increase the signal-to-noise ratio by increasing a pulse rate of at least one of the semiconductor sources from an initial non-zero pulse rate.” Ex. 1001 at 87:55-58.

75. Independent claim 8 of the '455 Patent recites “a wearable device ... including a light source comprising a driver and a plurality of semiconductor sources, ... the wearable device configured to increase the signal-to-noise ratio by

increasing light intensity of at least one of the semiconductor sources from an initial light intensity.” Ex. 1001 at 87:59-88:29. Dependent claim 14 recites “wherein the wearable device is further configured to increase the signal-to-noise ratio by increasing a pulse rate of at least one of the semiconductor sources from an initial non-zero pulse rate.” Ex. 1001 at 89:1-4.

76. Independent claim 15 of the ’455 Patent recites “a wearable device ... including a light source comprising a driver and a plurality of semiconductor sources, ... the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the semiconductor sources from an initial light intensity.” Ex. 1001 at 89:5-42. Dependent claim 20 recites “wherein the wearable device is further configured to increase the signal-to-noise ratio by increasing a pulse rate of at least one of the semiconductor sources from an initial non-zero pulse rate.” Ex. 1001 at 90:41-44.

77. I understand that in a prior IPR involving U.S. Patent No. 9,651,533, which is related to the ’455 Patent, the Board construed the phrase “a light source comprising a plurality of semiconductor sources that are light emitting diodes ... configured to increase signal-to-noise ratio by ... increasing a pulse rate of at least one of the plurality of semiconductor sources” to mean “a light source containing two or more light emitting diodes (semiconductor sources), wherein at least one of

the light emitting diodes is capable of having its pulse rate increased to increase a signal-to-noise ratio.” Ex. 1008 at 10-12.

78. Dependent claim 19 recites “the system is at least in part configured to detect an object.” Ex. 1001 at 90:36-37. I understand that in a prior IPR involving U.S. Patent No. 10,517,484, which is related to the ’455 Patent, the Board construed the term “to detect an object” to mean “to discover or notice the existence or presence of something.” Ex. 1011 at 8-10; Ex. 1013 at 3.

79. For purposes of this declaration, I have been asked to apply the Board’s constructions for these terms in my analysis of the grounds in the Petition.

80. I am informed and understand that the parties to the Texas Case have proposed no claim constructions for the ’455 Patent. Ex. 2049.

81. I am informed and understand that, pursuant to the Scheduling Order dated November 10, 2025, in the Delaware Case, Invalidity Contentions are due on January 21, 2026; the parties will exchange their proposed claim constructions by February 4, 2026; and the opening claim construction briefs are due on April 13, 2026. Ex. 2034, 2, 6. In other words, as of the date of this declaration, the parties have not formally proposed claim constructions in the Delaware Case.

82. 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 '455 Patent (or any other term or phrase in the '455 Patent).

IX. OVERVIEW OF ASSERTED GROUNDS AND REFERENCES IN THE PETITION

A. Petitioner's Obviousness Grounds

83. I understand that Petitioner and Dr. Mercier assert that claims 1-20 of the '455 Patent are obvious under 35 U.S.C. § 103 based on four (4) separate Grounds, as set forth in the table below (Petition at 11; Ex. 1003 at ¶ 79):

Ground	Claims	Asserted Reference(s)				
1	1-4, 8-11, 15-16	Lisogurski	Carlson	Soller		
2	5, 12	Lisogurski	Carlson	Soller	Tran	
3	17	Lisogurski	Carlson	Soller		Valencell-093
4	6-7, 13-14, 18-20	Lisogurski	Carlson	Soller	Tran	Valencell-093

B. Summary of Asserted References

84. I understand that Grounds 1-4 assert various combinations of the following references: "Lisogurski" (Ex. 1027), "Carlson" (Ex. 1028), "Soller" (Ex. 1030), "Tran" (Ex. 1031), and "Valencell-093" (Ex. 1032). Petition at 9-11. Specifically, I understand that Petitioner's Grounds rely on the combination of Lisogurski, Carlson, and Soller and also that combination in further combination with Tran and/or Valencell-093. Petition at 11. Herein, I refer to these alleged prior

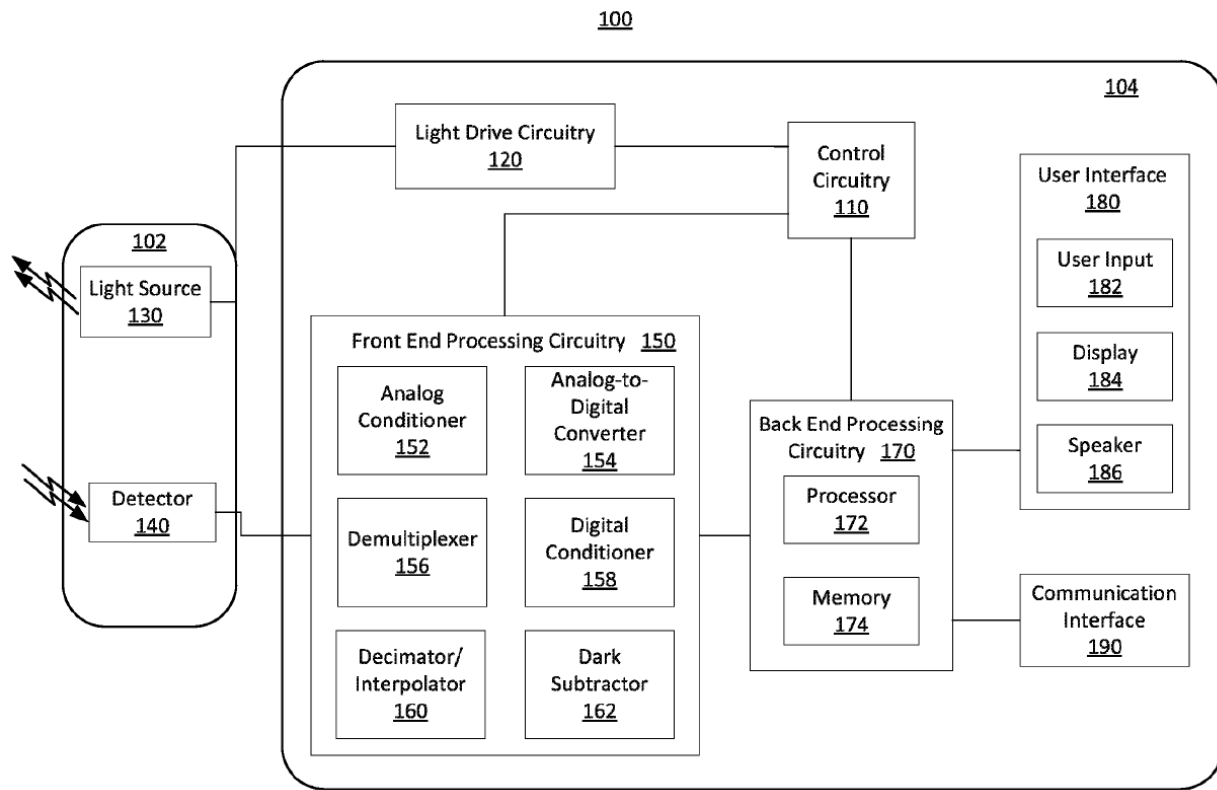


FIG. 1

Ex. 1027 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. 1027 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. 1027 at 4:42-62; 10:48-64. Front end processing circuitry 150 processes the electronic signal. Ex. 1027 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. 1027 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. 1027 at 24:58-25:5.

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

86. 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:

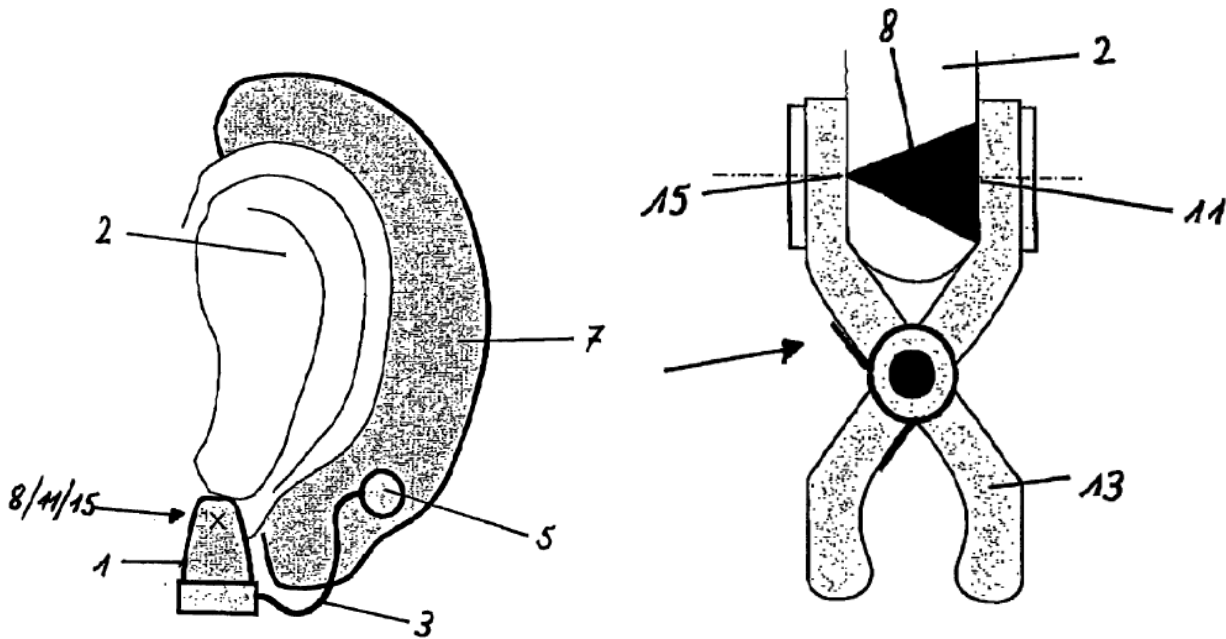


Figure 1

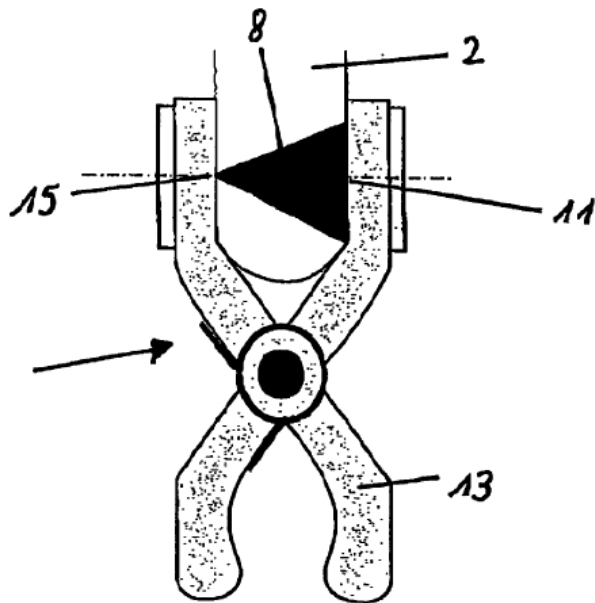


Figure 2

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.

3. Soller (Ex. 1030) (Grounds 1-4)

87. U.S. Patent No. 6,304,767 (“Soller”) describes a “measurement of blood hematocrit (Hct)” – “the volume percent of red blood cells in a blood sample.” Ex. 1030 at 1:17-20. Hematocrit is measured with “non-invasive optical and mathematical method... with an accuracy of approximately 99” and the “accuracy results from the complete analysis provided by the new optical method, which measures blood hematocrit by quantifying a plurality of red blood cell constituents.” Ex. 1030 at 1:49-52. Hematocrit is determined by “processing the optical spectrum with a mathematical model” that relates “optical properties of the plurality of red blood cell constituents to known blood hematocrit.” Ex. 1030 at 1:58-62. In one aspect, Soller “features a fiber optic device for determining blood hematocrit including an array of light sources...attached to a mount and a fiber optic cable ...for

delivering radiation to the sample.” Ex. 1030 at 3:16-22. Further, Soller is directed to using reference detectors in addition to reflectance detectors, with the goal of using the reference detectors to measure and account for variations in LED intensity. Ex. 1030 at 2:27-33, 2:58-63, 17:42-48.

4. Tran (Ex. 1031) (Grounds 2-4)

88. U.S. Patent No. 8,108,036 (“Tran”) describes a patient heart monitoring system that includes wireless nodes forming a wireless mesh network. Ex. 1031 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 a heart attack or stroke attack. Ex. 1031 at Abstract, 3:3-13. The wearable appliance may include sensors and non-invasively measure, for example, blood pressure. Ex. 1031 at 4:62-65, 9:23-30.

5. Valencell-093 (Ex. 1032) (Grounds 3-4)

89. U.S. Patent Appl. Pub. No. 2012/0197093 (“Valencell-093”) describes an “apparatus and methods for attenuating environmental interference.” Ex. 1032 at Abstract. Valencell-093 explains that “a medium (e.g., physiological material of a subject), having a region of interest, is monitored via a sensor module having at least one energy emitter for interrogating the medium with energy to generate an energy response associated with the medium.” Ex. 1032 at ¶ [0005].

90. Valencell-093 further describes that “[t]he sensor module includes an optical emitter, a detector, a motion/position sensor, a filter, and at least one processor that controls operations of the optical emitter, detector, and/or filter.” Ex. 1032 at ¶ [0012]. Valencell-093 additionally states that “[o]utput from the motion/position sensor is associated with the motion or position between the housing and ear of the subject.” Ex. 1032 at ¶ [0012].

X. OPINIONS ON GROUNDS IN THE PETITION

91. I understand that Petitioner has asserted obviousness in Grounds 1-4, as summarized above in Section IX, which collectively challenge claims 1-20 of the ’455 Patent, described above in Section VII. Petition at 11. It is my opinion that none of the challenged claims is obvious over the asserted prior art in any of Grounds 1-4.

A. Ground 1: Obviousness Based on Lisogurski, Carlson, and Soller (Claims 1-4, 8-11, 15-16)

92. I understand that Petitioner and Dr. Mercier argue for Ground 1 that claims 1-4, 8-11, and 15-16 of the ’455 Patent are obvious over Lisogurski, Carlson, and Soller. Petition at 11, 21-65; Ex. 1003 at ¶¶ 79, 115-255. I disagree for at least the reasons provided below.

1. Independent Claim 1

93. I disagree with Petitioner and Dr. Mercier’s assertion that claim 1 is obvious over Lisogurski, Carlson, and Soller.

94. Claim 1 of the '455 Patent includes limitation 1[a] that recites, in part, “a wearable device ... including a light source comprising a driver and a plurality of semiconductor sources.” Ex. 1001 at 86:45-49; Petition at 84. Based on my review, Petitioner and Dr. Mercier rely on Lisogurski’s sensor 102/312 as the claimed “wearable device,” light source 130 as the claimed “light source,” and at least light drive circuitry 120 as the claimed “driver.”¹ Petition at 29-32; Ex. 1003 at ¶¶ 122-27.

95. Limitation 1[a] recites “a light source *comprising* a driver.” Ex. 1001 at 86:46-47 (emphasis added); Petition at 84. Petitioner and Dr. Mercier recognize, however, that Lisogurski does not disclose that its light source 130 (alleged “light source”) “compris[es]” light drive circuitry 120 (alleged “driver”), as they instead rely on an alleged “modification” to relocate Lisogurski’s light drive circuitry 120. Petition at 31-32; Ex. 1003 at ¶¶ 126-27. Specifically, to meet “a light source comprising a driver” as recited in limitation 1[a], Petitioner and Dr. Mercier must at least show that a POSITA would have modified Lisogurski to relocate its light drive circuitry 120 (alleged “driver”) to within light source 130 (alleged “light source”)—

¹ To the extent Petitioner and Dr. Mercier rely on Lisogurski’s control circuitry 110 (in combination with light drive circuitry 120) for the claimed “driver,” Petitioner and Dr. Mercier’s position regarding the claimed “driver” is inconsistent and unclear as I explain in Section X.A.1.c.i below. Petition at 30-32; Ex. 1003 at ¶¶ 123-27.

although as I explain in Section X.A.1.c.ii below, Petitioner and Dr. Mercier fail to clearly argue this modification.

96. Lisogurski does not teach or render obvious the portion of limitation 1[a] that recites “a light source comprising a driver,” including because (i) Lisogurski does not disclose this limitation and (ii) a POSITA would not have been motivated to modify Lisogurski to relocate its light drive circuitry 120 to within light source 130.

a) Previous IPRs Regarding Related Patents

97. I understand that certain portions of the Petition and Dr. Mercier’s declaration rely on findings by the Board in prior IPR proceedings challenging patents related to the ’455 Patent, including: (i) the Board’s Final Written Decision in IPR2019-00916 (Ex. 1008, “’533-FWD”) regarding U.S. Patent No. 9,651,533 (Ex., 1004, “’533 Patent”) and (ii) the Board’s Final Written Decision in IPR2021-00453 (Ex. 1011, “’484-FWD”) regarding U.S. Patent No. 10,517,484 (Ex. 1005, “’484 Patent”). *E.g.*, Petition at 20, 29, 33; Ex. 1003 at ¶¶ 71-72, 127, 140.

98. However, the claimed “driver” recited in limitation 1[a] of the ’455 Patent is not recited in the claims of either the ’533 Patent or ’484 Patent, and Petitioner and Dr. Mercier do not rely on the ’533-FWD or ’484-FWD regarding Lisogurski allegedly teaching the claimed “driver.” *See* Ex. 1004 at 28:51-32:23; Ex. 1005 at 36:45-40:55; Petition at 30-31; Ex. 1003 at ¶¶ 123-25. To the extent that

Petitioner and Dr. Mercier rely on the Board's findings in the '533-FWD and '484-FWD, those prior findings do not directly address the claimed "driver" recited in the '455 Patent's claim limitation 1[a].

b) Lisogurski Does Not Disclose "a light source comprising a driver"

99. Lisogurski does not disclose "a light source comprising a driver" as recited in limitation 1[a] because Lisogurski does not disclose that its light drive circuitry 120 (alleged "driver") is within light source 130 (alleged "light source"). Instead, Lisogurski teaches that light drive circuitry 120 and light source 130 are two separate and distinct components of Lisogurski's system.

100. As depicted in the following annotated version of Lisogurski's Figure 1 and explained in the accompany description, Lisogurski's system includes light source 130 (red) as a first component located in sensor 102 (purple) and includes light drive circuitry 120 (blue) as a different component that is separate and distinct from light source 130 and is located in monitor 104 (green), which is separate and distinct from sensor 102:

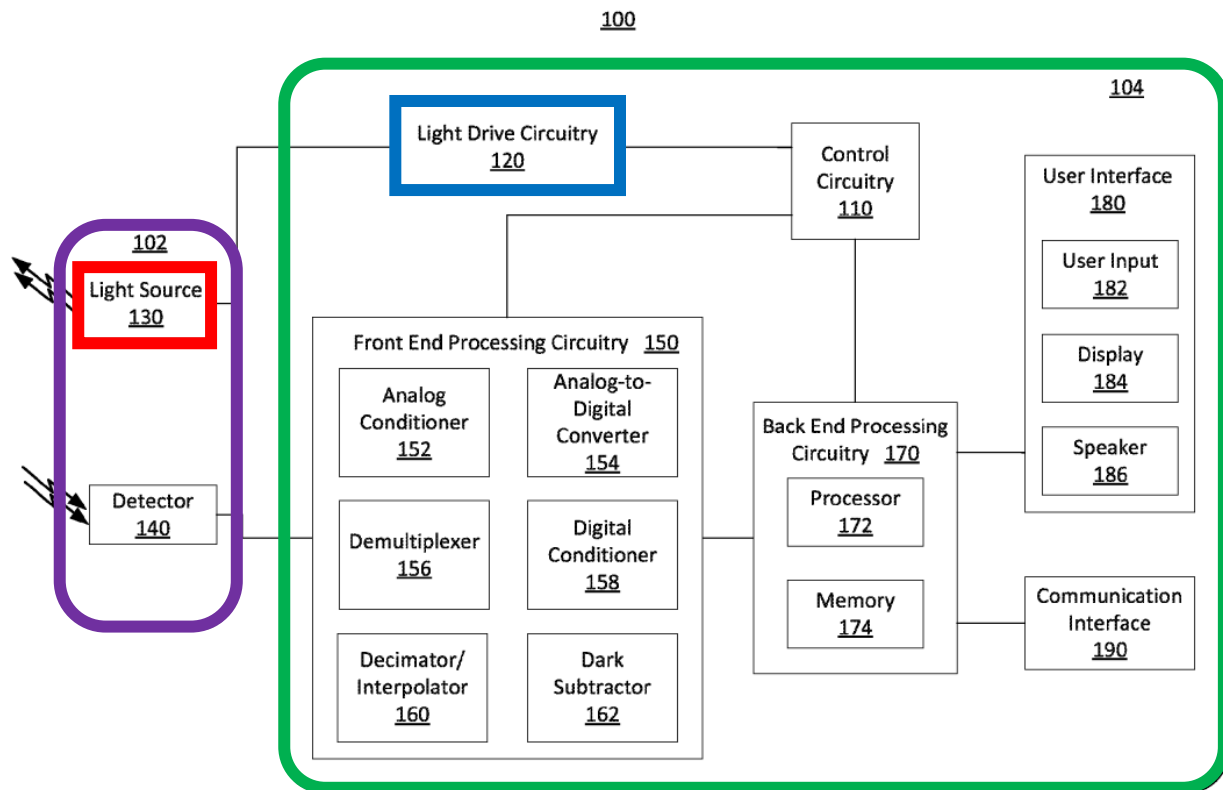


FIG. 1

Ex. 1027 at FIG. 1 (annotated), 10:42-49, 11:28-32

101. Based on my review, this Figure 1 and the accompanying description constitute Lisogurski's only disclosure regarding light drive circuitry 120, and Lisogurski does not disclose that light drive circuitry 120 can be located within, or otherwise combined with, light source 130. *See* Ex. 1027 at 11:28-66 (containing Lisogurski's only mentions of light drive circuitry 120).

102. Lisogurski states the following with respect to the monitoring system depicted in Figure 1: "In some embodiments the functionality of some of the components may be combined in a single component." Ex. 1027 at 15:66-16:4.

However, neither this statement nor the paragraph containing this statement in Lisogurski mentions either light source 130 or light drive circuitry 120, much less teaches that light drive circuitry 120 can be relocated within light source 130. *See* Ex. 1027 at 15:66-16:16. Instead, the paragraph containing that statement in Lisogurski discloses examples related to components in Figure 1 other than light source 130 and light drive circuitry 120. Ex. 1027 at 15:66-16:16. A POSITA would not have understood this statement in Lisogurski to apply to relocating light drive circuitry 120 to within light source 130 for the reasons discussed below.

103. Additionally, to the extent that Petitioner and Dr. Mercier argue that Lisogurski's control circuitry 110 also constitutes part of the claimed "driver," Lisogurski does not disclose that its control circuitry 110 is within light source 130 (alleged "light source"). Instead, Lisogurski teaches that control circuitry 110 and light source 130 are two separate and distinct components of Lisogurski's system, as shown in Figure 1. Ex. 1027 at FIG. 1. For example, as depicted in Lisogurski's Figure 1, Lisogurski's system includes light source 130 as a first component located in sensor 102 and includes control circuitry 110 as a different component that is separate and distinct from light source 130 and is located in monitor 104, which is separate and distinct from sensor 102. Ex. 1027 at FIG. 1. Moreover, Lisogurski's disclosures regarding control circuitry 110 do not disclose that control circuitry 110

can be located within, or otherwise combined with, light source 130. *See* Ex. 1027 at 11:28-66, 13:21-45, 16:9-12, 34:7-10.

104. Lisogurski does not disclose the claim limitation of “a light source comprising a driver.” Petitioner and Dr. Mercier appear to acknowledge this deficiency in Lisogurski, since they instead rely on an alleged “modification” of Lisogurski to meet this claim limitation. *See* Petition at 30-32; Ex. 1003 at ¶¶ 126-27.

c) Petitioner and Dr. Mercier Do Not Show that a POSITA Would Have Been Motivated to Modify Lisogurski to Meet the Claim Limitation Regarding “a light source comprising a driver”

105. For the portion of claim limitation 1[a] that recites “a light source comprising a driver,” I understand that Petitioner and Dr. Mercier rely on Lisogurski’s light source 130 as the claimed “light source” and rely on Lisogurski’s light drive circuitry 120 alone or in combination with control circuitry 110 as the claimed “driver.” Petition at 30-32; Ex. 1003 at ¶¶ 123, 125-27. As I explained above in Section X.A.1.b, Lisogurski does not disclose that light source 130 comprises light drive circuitry 120 or control circuitry 110. Thus, to meet this limitation of “a light source comprising a driver,” Petitioner and Dr. Mercier must show that a POSITA would have modified Lisogurski to relocate the alleged “driver” to *within* light source 130 (alleged “light source”).

106. In my opinion, Petitioner and Dr. Mercier do not show, with supporting evidence, that a POSITA would have been motivated to modify Lisogurski to relocate the alleged “driver” to within light source 130.

i. Petitioner and Dr. Mercier’s Position Regarding the Claimed “driver” Is Unclear

107. As an initial matter, Petitioner and Dr. Mercier do not (and cannot) show that a POSITA would have modified Lisogurski to relocate the alleged “driver” to within light source 130 because Petitioner and Dr. Mercier’s positions are inconsistent and unclear as to which component(s) of Lisogurski purportedly constitute the claimed “driver.” Petition at 30-32; Ex. 1003 at ¶¶ 123, 125-27.

108. The Petition does not clearly identify which component(s) of Lisogurski allegedly constitute the claimed “driver.” The Petition only uses the word “driver” when quoting the language of the ’455 Patent’s claims. Petition at 30, 84, 86, 88. The Petition never uses the word “driver” in discussing Lisogurski or its components.

109. Some aspects of the Petition suggest that the claimed “driver” corresponds to only Lisogurski’s light drive circuitry 120, as the Petition’s analysis for the relevant portion of limitation 1[a] mentions light drive circuitry 120 both in its description of Lisogurski’s disclosures and its argument about modification of Lisogurski, whereas control circuit 110 is mentioned only once and in the argument about modification. Petition at 30-31. Also, the Petition’s analysis for the relevant

portion of limitation 1[a] uses bold for light drive circuitry 120 but not control circuitry 110. Petition at 30-31. Also, the Petition's argument about modification refers to "[i]ntegrating the light drive circuitry 120 ... with the light source 130," with no mention of control circuitry 110. Petition at 31.

110. However, other aspects of the Petition, in contrast, suggest that the claimed "driver" corresponds to not only Lisogurski's light drive circuitry 120 but also control circuitry 110, as the Petition's argument about modification of Lisogurski for the relevant portion of limitation 1[a] refers to "motivat[ion] to combine the *control [circuitry]* and light drive circuitry" with sensor 102. Petition at 31 (emphasis added). Also, the Petition's analysis of the relevant portion of limitation 1[a] includes an annotated version of Lisogurski's Figure 1 that depicts both light drive circuitry 120 and control circuitry 110 in blue. Petition at 31-32.

111. Dr. Mercier's declaration also does not clearly identify which component(s) of Lisogurski allegedly constitute the claimed "driver." Some aspects of Dr. Mercier's declaration suggest that the claimed "driver" corresponds to only Lisogurski's light drive circuitry 120, as he states that "Lisogurski teaches a component ('light drive circuitry') ... , which a POSITA would have understood to be the 'driver.'" Ex. 1003 at ¶ 125. Dr. Mercier references limitation 1[a] as "requir[ing] the 'light drive circuitry 120' ... to be part of the light source 130," with no mention of control circuitry 110. Ex. 1003 at ¶ 126.

112. However, other aspects of Dr. Mercier’s declaration suggest that the claimed “driver” corresponds to not only Lisogurski’s light drive circuitry 120 but also control circuitry 110, as he uses the color blue for the claim term “driver” and likewise to identify Lisogurski’s control circuitry 110 in text and in an annotated version of Lisogurski’s Figure 1. Ex. 1003 at ¶¶ 123, 125-26. Dr. Mercier’s argument for modification of Lisogurski for this limitation 1[a] also refers several times to “combin[ing] the light drive circuitry and *control circuitry*” (or “combin[ing] *control circuitry 110* and light drive circuitry 120”) with sensor 102. Ex. 1003 at ¶¶ 126-27 (emphases added).

113. Thus, the Petition and Dr. Mercier’s declaration contain inconsistent and unclear positions regarding which component(s) of Lisogurski purportedly constitute the claimed “driver”: (1) light drive circuitry 120 alone or (2) light drive circuitry 120 along with control circuitry 110. Petition at 30-32; Ex. 1003 at ¶¶ 123, 125-27. Petitioner and Dr. Mercier, therefore, fail to specifically identify the claimed “driver” in Lisogurski.

ii. Petitioner and Dr. Mercier Fail to Clearly Argue a Modification of Lisogurski to Meet the Claim Limitation of “a light source comprising a driver”

114. As discussed above, Petitioner and Dr. Mercier rely on Lisogurski’s light source 130 as the claimed “light source” and rely on at least Lisogurski’s light drive circuitry 120 as the claimed “driver.” Petition at 30-32; Ex. 1003 at ¶¶ 123,

125-27. And, as I explain above in Section X.A.1.b, Lisogurski does not disclose that light source 130 comprises light drive circuitry 120. So, to meet limitation 1[a], which recites “a light source *comprising* a driver,” Petitioner and Dr. Mercier must show that Lisogurski would have been modified to relocate light drive circuitry 120 to within light source 130. However, Petitioner and Dr. Mercier fail to clearly make this argument. Petition at 31-32; Ex. 1003 at ¶¶ 126-27. That is, neither the Petition nor Dr. Mercier’s declaration clearly argues that a POSITA would have modified Lisogurski to relocate light drive circuitry 120 (alleged “driver”) to within light source 130 (alleged “light source”) as required by limitation 1[a]. Instead, the Petition and Dr. Mercier’s declaration suggest that Lisogurski’s light drive circuitry 120 would have merely been relocated to within sensor 102 in general, not specifically to within light source 130. Petition at 31-32; Ex. 1003 at ¶¶ 126-27.

115. The Petition’s analysis for the relevant portion of limitation 1[a] addresses modification of Lisogurski in a single paragraph containing only three sentences, and only the first two sentences describe the alleged modification. Petition at 31. The first sentence of this relevant paragraph alleges “[i]ntegrating the light drive circuitry 120 ... with the light source 130,” and the second sentence explains that this alleged “[i]ntegrat[ion]” means “[s]pecifically, ... combin[ing] ... light drive circuitry [120] ... with *the sensor unit*[],” i.e., “with the ... *device with the light source*.” Petition at 31 (emphases added); see Ex. 1027 at FIG. 1 (showing

that sensor 102 is the device with light source 130). This paragraph addressing modification of Lisogurski never clearly asserts that drive circuitry 120 would have been relocated to within light source 130 and instead only suggests that drive circuitry 120 would have been relocated to within sensor 102 that contains light source 130. Petition at 31. Thus, the Petition only argues that light drive circuitry 120 would have been combined with (or relocated into) sensor 102 that contains light source 130, not that light drive circuitry 120 would have been combined with (or relocated into) light source 130 itself. To the extent that the first sentence is intended to assert that light drive circuitry 120 would have been “[i]ntegrat[ed]” into light source 130 itself, such assertion is not consistent with, and not supported by, the second sentence, which merely addresses “combin[ing] ... light drive circuitry [120] ... with the sensor [102].” Petition at 31.

116. Similarly, the annotated version of Lisogurski’s Figure 1 in Petitioner’s analysis of the relevant portion of limitation 1[a] includes a blue arrow. Petition at 32. To the extent that this blue arrow in Petitioner’s annotated version of Lisogurski’s Figure 1 was intended to indicate the relocation of light drive circuitry 120 to within light source 130 itself (which is entirely unclear from the Petition), such modification is not addressed or supported in the text of the Petition. Petition at 31-32.

117. Dr. Mercier’s declaration also does not clearly assert that Lisogurski’s light drive circuitry 120 would have been relocated specifically into light source 130. Dr. Mercier’s analysis for the relevant portion of limitation 1[a] addresses modifications to Lisogurski in only two paragraphs. Ex. 1003 at ¶¶ 126-27. In those paragraphs, Dr. Mercier states that it “would have been ... obvious” for “the ‘light drive circuitry 120’ ... to be part of the light source 130.” Ex. 1003 at ¶ 126. This assertion is inconsistent with the remainder of those two paragraphs, which argue instead that light drive circuitry 120 would have been relocated within sensor 102, not specifically within light source 130. Ex. 1003 at ¶¶ 126-27; *see* Ex. 1027 at FIG. 1 (showing that sensor 102 is the device containing light source 130). Similarly, Dr. Mercier alleges that “existing ... sensors ... combined the driver and light source ... into a single finger-worn wearable device,” which merely addresses locating the driver in the same wearable device that contains the light source, not locating the driver in the light source itself. Ex. 1003 at ¶ 126.

iii. The Petition Does Not Show Motivation to Meet the Claim Limitation of “a light source comprising a driver”

118. As explained in Section X.A.1.c.ii above, the Petition does not clearly argue that a POSITA would have modified Lisogurski to relocate light drive circuitry 120 (alleged “driver”) to within light source 130 (alleged “light source”) as required by limitation 1[a], which recites “a light source comprising a driver.” However, even if the Petition had argued that a POSITA would have modified Lisogurski to relocate

its light drive circuitry 120 to within light source 130, the Petition still does not show that a POSITA would have been motivated to make this modification.

119. The Petition’s analysis for the portion of limitation 1[a] that recites “a light source comprising a driver” addresses alleged motivation to modify Lisogurski in only a single paragraph on page 31. Petition at 31.² Specifically, the Petition argues motivation to modify Lisogurski to meet the limitation of “a light source comprising a driver” in only the following two relevant sentences:

Integrating the light drive circuitry 120 in Figure 1 of Lisogurski with the light source 130 would have been an obvious modification that a POSITA would have been motivated to make, as Dr. Mercier explains and as the Board previously found. EX1003 ¶126; EX1008, 22-23(quoting EX1027, 16:2-9); EX1011, 24-45. Specifically, a POSITA would have been motivated to combine the control and light drive circuitry ... , which operate together, with the sensor unit/device with the light source, consistent with the disclosures in Lisogurski that multiple components can be combined and the market trends toward miniaturized electronics. EX1003 ¶126.

Petition at 31.

120. These two sentences, however, as explained above in Section X.A.1.c.ii, never assert that a POSITA would have modified Lisogurski to relocate light drive circuitry 120 (alleged “driver”) into light source 130 (alleged “light

² The other two paragraphs of Petitioner’s analysis for the relevant portion of limitation 1[a] do not address modification of Lisogurski, and I understand that the last sentence of the one relevant paragraph relates to whether a POSITA would have had a reasonable expectation of success for the alleged modification, not whether a POSITA would have had motivation for the modification, which I understand is different. Petition at 30-32.

source”) as required to meet the claim limitation of “a light source *comprising* a driver.” Petition at 31. They also do not address or explain why a POSITA allegedly would make such a modification given that they merely argue that light drive circuitry 120 would have been relocated to within sensor 102 that contains light source 130: “[s]pecifically, ... combin[ing] ... light drive circuitry [120] ... with *the sensor unit*[],” i.e., “with the ... *device with the light source*.” Petition at 31 (emphases added); *see* Ex. 1027 at FIG. 1 (showing that sensor 102 is the device with light source 130). Even if one were to relocate light drive circuitry 120 into sensor 102, that does not address or meet the claim limitation of “a *light source* comprising a driver” because Petitioner associates the claimed “light source” with Lisogurski’s light source 130, not sensor 102. Petition at 30-31.

121. The first sentence includes citations (with no explanation) to prior Board decisions (Ex. 1008 and Ex. 1011) and Dr. Mercier’s declaration (Ex. 1003), but as explained below in Section X.A.1.c.iv and Section X.A.1.c.v, respectively, neither those prior Board decisions nor Dr. Mercier’s declaration shows that a POSITA would have been motivated to relocate Lisogurski’s light drive circuitry 120 to within light source 130, because such modification is not addressed by those prior Board decisions or clearly argued by Dr. Mercier. Petition at 31.

122. The second sentence asserts that the modification would have been “consistent with the disclosures in Lisogurski that multiple components can be

combined and the market trends toward miniaturized electronics.” Petition at 31 (citing only Ex. 1003 at ¶ 126). But this assertion contains no citation or explanation regarding the alleged “disclosures in Lisogurski” or “market trends,” much less explanation of how such unspecified “disclosures in Lisogurski” or “market trends” purportedly relate to Lisogurski’s light drive circuitry 120, light source 130, or any alleged motivation for any specific modification involving light drive circuitry 120 and light source 130. Petition at 31. For example, while the Petition refers to “market trends toward miniaturized electronics,” it fails to explain why this would have motivated a POSITA to relocate Lisogurski’s light drive circuitry 120 into light source 130 or how such relocation would have purportedly resulted in “miniaturized electronics.” Petition at 31. Further, a POSITA would have understood that such relocation of Lisogurski’s light drive circuitry 120 into light source 130 would not have resulted in “miniaturized electronics” (Petition at 31) because this modification would not have substantially changed the size or number of Lisogurski’s overall system components, specifically with respect to sensor 102 and monitor 104. Ex. 1027 at FIG. 1.

123. Based on my review, I understand that the Petition’s reference to “disclosures in Lisogurski that multiple components can be combined” may refer to Lisogurski’s disclosure at 16:2-9. Petition at 31 (citing Ex. 1003 at ¶ 126 (citing Ex. 1027 at 16:2-9)). This portion of Lisogurski states: “the functionality of some of the

components may be combined in a single component” and “the functionality of some of the components of monitor 104 ... may be divided over multiple components.” Ex. 1027 at 16:2-9. The Petition, however, does not explain specifically how this purportedly applies to Lisogurski’s light drive circuitry 120, light source 130, or any alleged modification involving light drive circuitry 120 and light source 130. For example, Lisogurski states that its disclosures at 16:2-9 only apply to “some of the components” (e.g., “the functionality of *some* of the components may be combined in a single component”), and the Petition does not explain if or how light drive circuitry 120 and light source 130 together qualify as “some of the components.” Ex. 1027 at 16:2-9 (emphasis added); Petition at 31. Additionally, a POSITA would not have understood this disclosure in Lisogurski at 16:2-9 to apply to relocating light drive circuitry 120 to within light source 130 for the reasons discussed in Section X.A.1.d below.

124. I understand that the Board’s ’533-FWD relied on this disclosure in Lisogurski at 16:2-9 to support its finding that a POSITA would have modified Lisogurski to relocate light drive circuitry 120 to within sensor 102. Ex. 1008 at 22-23 (citing Lisogurski at 16:2-4, 16:7-9). However, as explained further in Section X.A.1.c.iv below, the ’533-FWD only considered and addressed relocating light drive circuitry 120 from monitor 104 to within *sensor 102*, not relocating it to within *light source 130* as required by limitation 1[a]. Ex. 1008 at 22-23 (addressing the

modification of “relocating ... light drive circuitry 120 ... to sensor 102,” with no mention of light source 130 for this modification).

125. Following the Petition’s two relevant sentences discussed above, the Petition includes an annotated version of Lisogurski’s Figure 1. Petition at 32. But this annotated version of Figure 1 alone does not explain any motivation to relocate light drive circuitry 120 from monitor 104 into light source 130, and neither does the text or citations accompanying this annotated version of Figure 1. The only accompanying text is the two sentences discussed above, which fail to show motivation for the reasons explained above. Petition at 31-32. And the only accompanying citation is to two paragraphs of Dr. Mercier’s declaration (i.e., paragraphs 123-24) that do not mention light drive circuitry 120 and do not discuss any proposed modification or alleged motivation. Petition at 32 (citing Ex. 1003 at ¶¶ 123-24).

iv. Previous Board Decisions Do Not Address Motivation to Meet the Claim Limitation of “a light source comprising a driver”

126. The previous Board decisions cited in the Petition and by Dr. Mercier do not address or support motivation to relocate Lisogurski’s light drive circuitry 120 (alleged “driver”) to within light source 130 (alleged “light source”) as required here for limitation 1[a], which recites “a light source comprising a driver.” *See* Petition at 31.

127. The Petition argues that “the Board previously found” motivation to modify Lisogurski, citing to the ’533-FWD (Ex. 1008) and ’484-FWD (Ex. 1011). Petition at 31 (citing Ex. 1008 at 22-23; Ex. 1011 at 24-45). But the Petition does not include any discussion or explanation regarding the cited Board decisions or what “the Board previously found.” Petition at 31.

128. The portion of the ’533-FWD (Ex. 1008) cited by the Petition does not provide or support motivation to relocate Lisogurski’s light drive circuitry 120 into light source 130. Petition at 31 (citing Ex. 1008 at 22-23). According to the ’533-FWD, the only relevant motivation that was proposed by the petitioner in that proceeding and found by the Board was the motivation to relocate Lisogurski’s light drive circuitry 120 to within sensor 102, not within light source 130. Ex. 1008 at 22-23 (“Petitioner’s proposed combination relocates some components of Lisogurski’s monitor 104/314 *to sensor 102/312*”; “Petitioner’s proposed combination ... involves relocating ... light drive circuitry 120 ... *to sensor 102*”; “Petitioner articulates sufficient reasoning ... why a [POSITA] would have modified Lisogurski’s *sensor 102/312* ... in the manner proposed”). The portion of the ’533-FWD cited by the Petition regarding modifying Lisogurski for limitation 1[a] contains no mention of light source 130, much less discussion of relocating light drive circuitry 120 to within light source 130. Petition at 31 (citing Ex. 1008 at 22-23). Also, I understand that in other portions of the ’533-FWD that compare

Lisogurski to the '533 Patent claims, the '533-FWD discusses a “light drive signal” that Lisogurski’s light drive circuitry 120 sends to light source 130, which shows that the modification of Lisogurski in the '533-FWD did not relocate light drive circuitry 120 to within light source 130. Ex. 1008 at 27, 32-33.

129. Dr. Mercier’s declaration acknowledges that the cited portion of the '533-FWD addresses relocating Lisogurski’s light drive circuitry 120 into just sensor 102, not light source 130, as he cites the '533-FWD and states that “the Board previously found that a POSITA would have been motivated to combine ... light drive circuitry ... into *the device containing the light source*”—i.e., into sensor 102. Ex. 1003 at ¶127 (citing Ex. 1008 at 22-23); *see* Ex. 1027 at FIG. 1.

130. I understand that the following annotated version of Lisogurski’s Figure 1 was included in the '533-FWD:

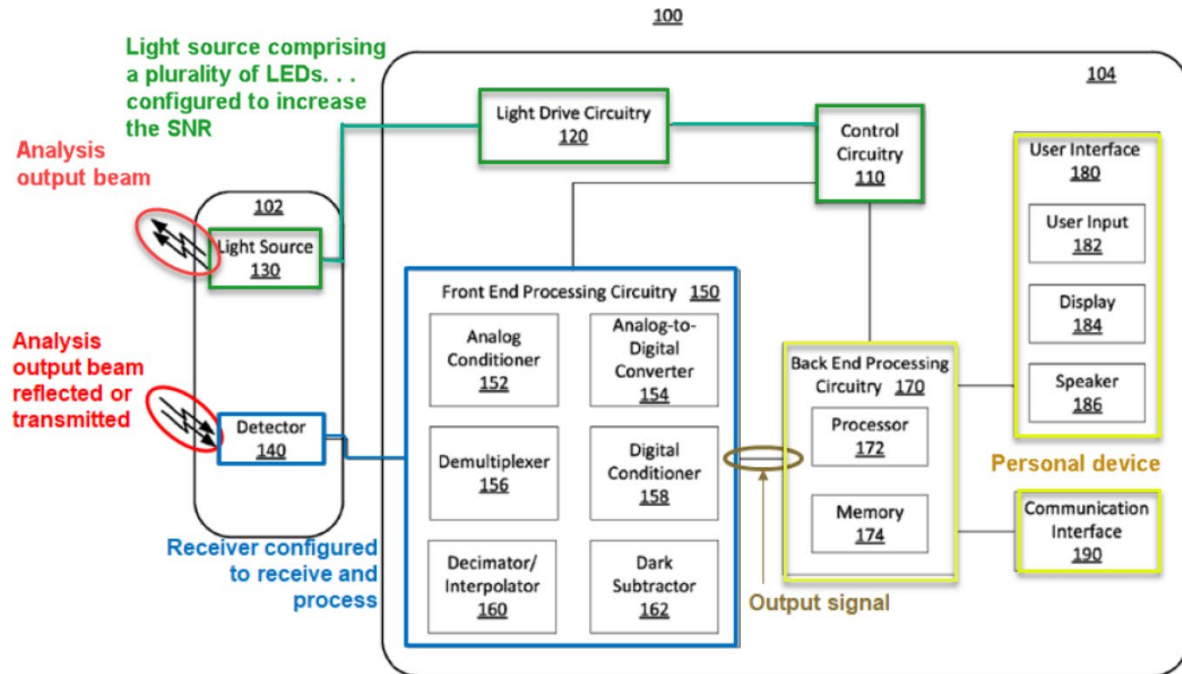


FIG. 1

Ex. 1008 at 22. These annotations, however, do not indicate any finding by the Board involving relocating light drive circuitry 120 to within light source 130, because: (1) as I understand it, these annotations came from the petitioner in the prior '533 IPR, not from the Board, because the '533-FWD states that this “combine[s]” “a series of [p]etitioner-modified versions of Lisogurski’s Figure 1””; and (2) the '533-FWD states that the modification illustrated by this annotated version of Lisogurski’s Figure 1 involves relocating light drive circuitry 120 to sensor 102, not light source 130. '533-FWD at 22-23 (“Petitioner’s proposed combination relocates some components ... *to sensor 102/312*, as illustrated in ... Petitioner-modified versions of Lisogurski’s Figure 1, which we combine into a single modified version Modified Figure 1 of Lisogurski illustrates Petitioner’s proposed combination,

which involves relocating ... light drive circuitry 120 ... *to sensor 102* as illustrated.” (emphases added).

131. The portion of the '484-FWD (Ex. 1011) cited by the Petition, like the cited portion of the '533-FWD, also does not provide or support motivation to relocate Lisogurski's light drive circuitry 120 into light source 130. Petition at 31 (citing Ex. 1011 at 24-45). The Petition cites a large portion of the '484-FWD (i.e., pages 24-45) but provides no explanation. Petition at 31 (citing Ex. 1011 at 24-45). For example, the Petition does not identify any particular finding in the '484-FWD. Petition at 31. Also, based on my review, the portion of the '484-FWD cited by the Petition regarding modifying Lisogurski for limitation 1[a] contains only a single mention of light drive circuitry 120—i.e., stating merely that “Petitioner cites Lisogurski as disclosing front end processing circuitry 150 operating synchronously with light drive circuitry 120”—and contains no discussion regarding both light drive circuitry 120 and light source 130, much less discussion of relocating light drive circuitry 120 to within light source 130. Petition at 31 (citing Ex. 1011 at 24-45).

v. Dr. Mercier's Declaration Does Not Show Motivation to Meet the Claim Limitation of “a light source comprising a driver”

132. As explained in Section X.A.1.c.ii above, Dr. Mercier's declaration does not argue that a POSITA would have modified Lisogurski to relocate light drive

circuitry 120 (alleged “driver”) to within light source 130 (alleged “light source”) as required by limitation 1[a]. However, even if Dr. Mercier’s declaration argued that a POSITA would have modified Lisogurski to relocate its light drive circuitry 120 to within light source 130, Dr. Mercier’s declaration does not show that a POSITA would have been motivated to make this modification with supporting evidence.

133. Based on my review and understanding, Dr. Mercier’s analysis for the portion of limitation 1[a] that recites “a light source comprising a driver” addresses alleged motivation to modify Lisogurski in only two relevant paragraphs: Paragraphs 126 and 127.³ Ex. 1003 at ¶¶ 126-27. Additionally, I understand that the corresponding argument in the Petition cites only one of these paragraphs in Dr. Mercier’s declaration: Paragraph 126. Petition at 31 (citing Ex. 1003 at ¶ 126).

134. In paragraph 126, Dr. Mercier first asserts the following based on Lisogurski’s disclosure at 16:2-9:

Specifically, Lisogurski expressly suggests “the functionality of some of the components may be combined in a single component” and that “the functionality of some of the components of monitor 104...may be divided over multiple components.” EX1027, 16:2–9. A POSITA would have been motivated to combine the light drive circuitry 120 ... into the same device as the light source 130 based on this suggestion in Lisogurski alone.

³ The other paragraphs of Petitioner’s analysis for the relevant portion of limitation 1[a] do not address modification of Lisogurski. Ex. 1003 at ¶¶ 123-25.

Ex. 1003 at ¶ 126.⁴ This assertion, however, as explained above in Section X.A.1.c.ii, merely suggests that a POSITA would have modified Lisogurski to relocate light drive circuitry 120 “into *the same device as* the light source 130”—i.e., into sensor 102 that contains light source 130—not that a POSITA would have relocated light drive circuitry 120 (alleged “driver”) into light source 130 (alleged “light source”) as required to meet the claim limitation of “a light source *comprising* a driver.” Ex. 1003 at ¶ 126; *see* Ex. 1027 at FIG. 1 (showing that sensor 102 is the device with light source 130). Because Dr. Mercier’s assertion does not address that requisite modification to begin with, it does not (and cannot) address or explain motivation for such modification.

135. Dr. Mercier’s assertion fails to show that a POSITA would have been motivated to make such a modification. Ex. 1003 at ¶ 126. Dr. Mercier merely quotes

⁴ Paragraph 126 of Dr. Mercier’s declaration also cites Lisogurski’s disclosure at 16:2-9 for the assertion that “combining the light drive circuitry ... with the device containing the light source would have been a routine modification with a reasonable expectation of success.” Ex. 1003 at ¶ 126 (citing Ex. 1027 at 16:2-9). I understand that this assertion about “success” relates to whether a POSITA would have had a reasonable expectation of success for the alleged modification, not whether a POSITA would have had motivation for the modification, which I understand is different. Ex. 1003 at ¶ 126. Regardless, in my opinion, this assertion about “success” does not explain or show that a POSITA would have been motivated to relocate Lisogurski’s light drive circuitry 120 into light source 130, including because this assertion about “success” addresses a different modification: “combining the light drive circuitry ... with *the device containing the light source*,” i.e., with sensor 102. Ex. 1003 at ¶ 126; Ex. 1027 at FIG. 1 (showing that sensor 102 is the device containing light source 130).

from Lisogurski's disclosure at 16:2-9 and then, with no analysis, states that "[a] POSITA would have been motivated ... based on this suggestion in Lisogurski alone." Ex. 1003 at ¶ 126. Dr. Mercier does not explain specifically how this disclosure in Lisogurski at 16:2-9 purportedly applies to Lisogurski's light drive circuitry 120, light source 130, or any alleged modification involving light drive circuitry 120 and light source 130. For example, Lisogurski states that its disclosures at 16:2-9 only apply to "some of the components," and Dr. Mercier does not explain if or how light drive circuitry 120 and light source 130 together qualify as "some of the components." Ex. 1027 at 16:2-9; Ex. 1003 at ¶ 126.

136. As explained in Section X.A.1.c.iii above, Lisogurski's disclosure at 16:2-9 does not provide motivation for relocating light drive circuitry 120 into light source 130 for several reasons. For example, this disclosure in Lisogurski states that only "*some* of the components may be combined." Ex. 1027 at 16:2-4 (emphasis added). And neither this disclosure in Lisogurski at 16:2-9 nor the paragraph containing this disclosure in Lisogurski mentions either light source 130 or light drive circuitry 120, much less teaches that light drive circuitry 120 can be relocated to within light source 130. *See* Ex. 1027 at 15:66-16:16. Instead, this paragraph in Lisogurski discloses examples related to components in Figure 1 other than light source 130 and light drive circuitry 120. Ex. 1027 at 15:66-16:16. A POSITA would not have understood this disclosure in Lisogurski at 16:2-9 to apply to relocating

light drive circuitry 120 to within light source 130 for the reasons discussed in Section X.A.1.d below.

137. Also, as discussed above in Sections X.A.1.c.iii and X.A.1.c.iv, I understand that the Board’s ’533-FWD relied on this disclosure in Lisogurski at 16:2-9 to find motivation to relocate light drive circuitry 120 to within *sensor 102*, not within *light source 130* as required here to meet limitation 1[a]. Ex. 1008 at 22-23 (citing Lisogurski at 16:2-4, 16:7-9). Here, Dr. Mercier fails to explain why this disclosure in Lisogurski at 16:2-9 would purportedly motivate a POSITA to modify Lisogurski beyond what the Board found in the ’533-FWD—i.e., to relocate light drive circuitry 120 specifically to within light source 130 rather than just within sensor 102 as the Board found in the ’533-FWD. Ex. 1003 at ¶ 126; Ex. 1008 at 22-23.

138. In paragraph 126, Dr. Mercier next asserts motivation based on alleged “market trends”:

Furthermore, a POSITA would have been motivated to combine the light drive circuitry ... with the same device as the light source based on the market trends I discussed above, calling for increased portability for electronic medical monitoring systems. *Supra* § V.B.

Ex. 1003 at ¶ 126. This assertion, however, as explained above in Section X.A.1.c.ii, merely suggests that a POSITA would have modified Lisogurski to combine light drive circuitry 120 “with *the same device as* the light source”—i.e., with sensor 102 that contains light source 130—not that a POSITA would have relocated light drive

circuitry 120 (alleged “driver”) into light source 130 (alleged “light source”) as required to meet the claim limitation of “a light source *comprising* a driver.” Ex. 1003 at ¶ 126; *see* Ex. 1027 at FIG. 1 (showing that sensor 102 is the device with light source 130). Because Dr. Mercier’s assertion does not address that requisite modification to begin with, it does not (and cannot) address or explain motivation for such modification.

139. Dr. Mercier’s alleged “market trends” assertion also fails to show that a POSITA would have been motivated to modify Lisogurski to relocate light drive circuitry 120 into light source 130. Dr. Mercier’s analysis for limitation 1[a] provides no discussion or evidence of the alleged “market trends,” much less any explanation regarding how those alleged “market trends” purportedly relate to the teachings of Lisogurski or would have specifically motivated a POSITA to modify Lisogurski to relocate its light drive circuitry 120 to within light source 130. Ex. 1003 at ¶ 126. Dr. Mercier’s analysis for limitation 1[a] asserts that the “market trends ... call[ed] for increased portability for electronic medical monitoring systems,” but even accepting this as true, Dr. Mercier does not explain how “increased portability” would have been achieved from any alleged modification of Lisogurski, much less from relocating light drive circuitry 120 from monitor 104 to light source 130. Ex. 1003 at ¶ 126. Further, a POSITA would have understood that such relocation of Lisogurski’s light drive circuitry 120 into light source 130 would not have resulted

in “increased portability” (Ex. 1003 at ¶ 126) because this modification would not have substantially changed the size or number of Lisogurski’s overall system components, specifically with respect to sensor 102 and monitor 104. Ex. 1027 at FIG. 1. Even if “market trends ... call[ed] for increased portability for electronic medical monitoring systems” as Dr. Mercier asserts (Ex. 1003 at ¶ 126), this would not have motivated a POSITA to modify Lisogurski to relocate light drive circuitry 120 to within light source 130.

140. Dr. Mercier’s assertion regarding alleged “market trends” cross-references Section V.B of his declaration (i.e., paragraphs 52-62 of his declaration). Ex. 1003 at ¶¶ 126 (citing “§ V.B”), 52-62 (Section V.B). Section V.B of Dr. Mercier’s declaration similarly fails to explain any motivation to modify Lisogurski to relocate light drive circuitry 120 to within light source 130, as Section V.B of Dr. Mercier’s declaration contains no discussion or citation of Lisogurski—including no mention of light drive circuitry 120, light source 130, or any other “circuitry” or “light source”—much less any explanation regarding how market trends alleged in Section V.B would have purportedly motivated a POSITA to relocate light drive circuitry 120 to within light source 130. Ex. 1003 at ¶¶ 52-62. Also, in my opinion, the market trends that Dr. Mercier alleges in Section V.B of his declaration would not have motivated a POSITA to make such modification to Lisogurski, including

because of the reasons discussed in Section X.A.1.d below with respect to there being no motivation for this modification.

141. In paragraph 126, Dr. Mercier next asserts motivation based on alleged “existing ... sensors”:

Further, a POSITA would have considered this modification obvious in view of existing wearable sensors (e.g., Nonin Onyx 9500 finger clip sensors) that combined the driver and light source (and all other functionality) into a single finger-worn wearable device, and existed prior to the purported priority date of the '455 patent.

Ex. 1003 at ¶ 126. This assertion, however, as explained above in Section X.A.1.c.ii, merely addresses locating a driver in the same “wearable device” that contains the light source, not locating the driver in the light source itself. Ex. 1003 at ¶ 126. Indeed, Dr. Mercier does not assert that the alleged “existing ... sensors” include an arrangement in which the purported driver is located within the purported light source. At best, Dr. Mercier’s assertion regarding “existing ... sensors” relates to relocating light drive circuitry 120 merely into sensor 102 that contains light source 130, not relocating light drive circuitry 120 (alleged “driver”) into light source 130 (alleged “light source”) as required to meet the claim limitation of “a light source *comprising* a driver.” Ex. 1003 at ¶ 126; *see* Ex. 1027 at FIG. 1 (showing that sensor 102 is the device with light source 130). Because Dr. Mercier’s assertion does not address that requisite modification to begin with, it does not (and cannot) address or explain motivation for such modification.

142. Dr. Mercier’s alleged “existing ... sensors” assertion fails to show that a POSITA would have been motivated to make such a modification. Based on my review, Dr. Mercier does not cite any evidence for this assertion regarding “existing ... sensors.” Ex. 1003 at ¶ 126. In particular, Dr. Mercer’s assertion regarding “existing ... sensors” only identifies one such alleged existing sensor: “Nonin Onyx 9500 finger clip sensors,” which are also mentioned in one other paragraph of Dr. Mercier’s declaration (¶ 144). Ex. 1003 at ¶¶ 126, 144. But Dr. Mercier does not provide any evidence regarding these alleged “Nonin Onyx 9500 ... sensors,” including no evidence regarding these alleged sensors’ prior art status, build, or functionality. Ex. 1003 at ¶¶ 126, 144.

143. Dr. Mercier’s assertion regarding “existing ... sensors” does not identify or argue any specific motivation for why a POSITA would have modified Lisogurski based on the alleged “existing ... sensors (e.g., Nonin Onyx 9500 ... sensors).” Ex. 1003 at ¶ 126. Instead, based on my review, Dr. Mercier relies on the purported “exist[ence]” of alleged “wearable sensors (e.g., Nonin Onyx 9500 ... sensors)” as reason for modifying Lisogurski. Ex. 1003 at ¶ 126. Dr. Mercier does not explain how those alleged “existing ... sensors (e.g., Nonin Onyx 9500 ... sensors)” compare to Lisogurski or why a POSITA would have purportedly modified Lisogurski to implement any aspects of the alleged “existing sensors.” Ex. 1003 at ¶ 126. In my opinion, the existence of alleged “wearable sensors (e.g., Nonin

Onyx 9500 ... sensors)” as Dr. Mercier describes, even if true, would not have motivated a POSITA to modify Lisogurski to relocate light drive circuitry 120 to be within light source 130, as discussed in Section X.A.1.d. Ex. 1003 at ¶ 126.

144. Dr. Mercier’s assertion regarding “existing ... sensors” argues that “a POSITA would have considered this modification [to Lisogurski] obvious *in view of* existing wearable sensors (e.g., Nonin Onyx 9500 finger clip sensors).” Ex. 1003 at ¶ 126. But Ground 1 asserts the combination of “Lisogurski in view of Carlson and Soller” and does not assert Lisogurski in view of the “existing ... sensors” alleged in Dr. Mercier’s paragraph 126 such as alleged “Nonin Onyx 9500 ... sensors.” Ex. 1003 at ¶¶ 79, 126; Petition at 11.

145. In paragraph 127, Dr. Mercier refers to an alleged previous finding by the Board:

I understand that the Board previously found that a POSITA would have been motivated to combine control circuitry 110 and light drive circuitry 120 in Lisogurski’s Figure 1 into the device containing the light source, and that the Federal Circuit affirmed that finding. EX1008, 22–23 (quoting Lisogurski, 16:2–4, 16:7–9), *aff’d* EX1009; *see also* EX1011, 24–25, EX1012 n.2.

Ex. 1003 at ¶ 127. This statement, however, as explained above in Section X.A.1.c.ii, merely addresses modifying Lisogurski to combine light drive circuitry 120 “into *the device containing the light source*”—i.e., into sensor 102—not modifying Lisogurski to relocate light drive circuitry 120 (alleged “driver”) into light source 130 (alleged “light source”) as required to meet the claim limitation of “a light source

comprising a driver.” Ex. 1003 at ¶ 127; *see* Ex. 1027 at FIG. 1 (showing that sensor 102 is the device containing light source 130).

146. Dr. Mercier relies on the '533-FWD (Ex. 1008) for this assertion. As explained above in Section X.A.1.c.iv, this portion of the '533-FWD only addresses relocating Lisogurski's light drive circuitry 120 into sensor 102, not into light source 130. Ex. 1003 at ¶ 127 (citing Ex. 1008 at 22-23); *see* Ex. 1008 at 22-23 (“Petitioner's proposed combination relocates some components of Lisogurski's monitor 104/314 **to sensor 102/312**”; “Petitioner's proposed combination ... involves relocating ... light drive circuitry 120 ... **to sensor 102**”; “Petitioner articulates sufficient reasoning ... why a [POSITA] would have modified Lisogurski's **sensor 102/312** ... in the manner proposed”). For example, Dr. Mercier's cited portion of the '533-FWD does not even mention Lisogurski's light source 130. Ex. 1008 at 22-23.

147. Dr. Mercier also cites the '484-FWD (Ex. 1011), but as explained above in Section X.A.1.c.iv, the cited portion of the '484-FWD also does not address relocating Lisogurski's light drive circuitry 120 into light source 130. Ex. 1003 at ¶ 127 (citing Ex. 1011 at 24-25); *see* Ex. 1011 at 24-25.

d) A POSITA Would Not Have Been Motivated to Modify Lisogurski to Meet the Claim Limitation Regarding “a light source comprising a driver”

148. As explained above, Petitioner and Dr. Mercier failed to show that a POSITA would have modified Lisogurski to relocate light drive circuitry 120 (alleged “driver”) to *within* light source 130 (alleged “light source”). Petition at 30-32; Ex. 1003 at ¶¶ 125-27. A POSITA would not have been motivated to make this modification to relocate Lisogurski’s light drive circuitry 120 to within light source 130 for at least the following additional reasons.

149. As explained above, Lisogurski teaches that light drive circuitry 120 provides or sends a light drive signal *to* light source 130. Ex. 1027 at 11:28-12:6, FIG. 1. This is Lisogurski’s only discussion of light drive circuitry 120. A POSITA would have understood light drive circuitry 120 and light source 130 to be separate and distinct components, with no overlap, and would not have been motivated to modify Lisogurski to relocate light drive circuitry 120 to within light source 130. For example, a POSITA would not have understood Lisogurski to teach that a component would send a signal to itself or be motivated to modify Lisogurski in a way that would cause a component to send a signal to itself. Because Lisogurski teaches that the purpose of light drive circuitry 120 is to provide or send a light drive signal *to* light source 130, a POSITA would not have relocated light drive circuitry 120 to within light source 130, as Petitioner and Dr. Mercier’s argument requires,

because this would cause light source 130 to effectively send a signal to itself. Ex. 1027 at 11:28-12:6. A POSITA would not have made such a modification that would result in a component sending a signal to itself because, for example, such a design would create unnecessary redundancy and inefficiency.

150. Also, a POSITA would not have been motivated to relocate Lisogurski's light drive circuitry 120 to within light source 130 because this would give rise to undesirable heat transfer issues. Ex. 2056; Ex. 2057 at 10-11. Lisogurski recognizes the undesirability of the heating effects caused by light emitters such as light source 130, and Lisogurski expresses a desire to reduce these undesirable heating effects. Ex. 1027 at 1:17-19 (describing desirability of "reduc[ing] heating effects of the emitters"), 3:58-60 (describing a "desir[e] to ... reduce heating effects caused by an emitter"), 5:7-9 (describing desirability of "reduc[ing] the impact of heating effects caused by a light source").

151. A POSITA would have understood, including based on Lisogurski's own teachings, that Lisogurski's light source 130 generates heat and that relocating light drive circuitry 120 to within light source 130 would put light drive circuitry 120 at risk of being destroyed or otherwise compromised due to heat generated by and transferred from light source 130. Ex. 2056; Ex. 2057 at 10-11. A POSITA would understand that this heat transfer issue is especially a risk and a concern in this situation where Petitioner and Dr. Mercier rely on embodiments of Lisogurski

in which light source 130 emits infrared (IR) light, for oximetry purposes. Petition at 52-55; Ex. 1003 at ¶¶ 185, 188, 190, 192-93, 195-98; Ex. 2056.

152. An LED generates heat during operation. The generated heat is dissipated through conductive and radiative heat transfer. In the case of an infrared (IR) LED for biomeasurements, the radiative heat falls within the same spectral range as the IR light and can interfere with the measurement. It is important to manage heat transfer and dissipation from the LED, for example, through conductive heat transfer, to avoid the undesirable effects of radiative heat dissipation. Based on this heat transfer issue and the risk that light drive circuitry 120 may be destroyed or compromised by heat from light source 130 if relocated to within light source 130, a POSITA would have been dissuaded from making this modification or at least would not have been motivated to make this modification.

153. Also, a POSITA would not have been motivated to make this modification because a combined light-source-and-driver would result in, for example, unnecessarily increased cost, complexity, complication, and sourcing and design issues. For example, a POSITA would have generally understood that Lisogurski's light source 130 and light drive circuitry 120 are standard components that are designed and fabricated separately and that integration of light drive circuitry 120 into light source 130 would require more specialized and complicated design and fabrication, including due to the heat issues described above. Indeed, Lisogurski

described the light source 130 and light drive circuitry 120 as separate and distinct components and depicted them separately in its system diagram. Ex. 1027 at FIG. 1, 10:42-49, 11:28-32.

2. Dependent Claim 2

154. I disagree with Petitioner and Dr. Mercier's assertion that claim 2 is obvious over Lisogurski, Carlson, and Soller.

155. Claim 2 depends from independent claim 1. Petitioner and Dr. Mercier's analysis of claim 2 focuses on the additional limitations of claim 2 and does not address any of the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 1. Petition at 56-61; Ex. 1003 at ¶¶ 202-12.

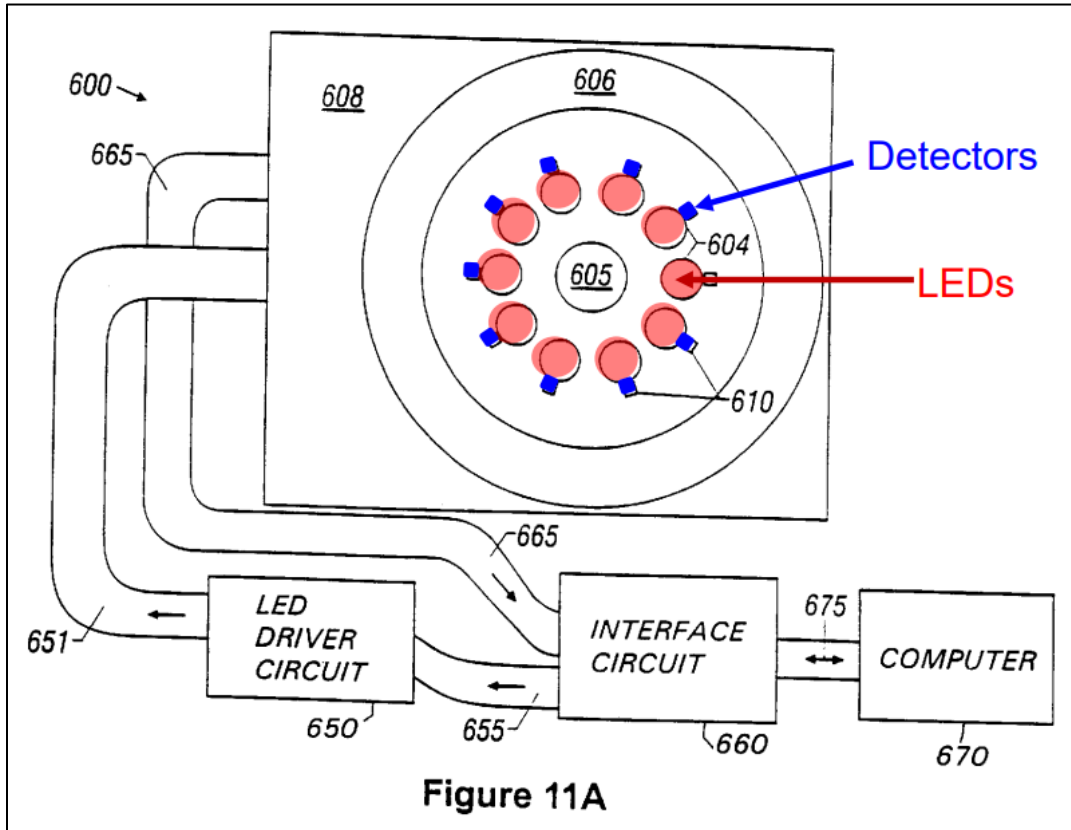
156. Therefore, Lisogurski, Carlson, and Soller do not render obvious claim 2 for at least the same reasons explained in Section X.A.1 above with respect to independent claim 1.

157. Additionally, Lisogurski, Carlson, and Soller do not render obvious the limitations recited in claim 2. I understand that claim 2 of the '455 Patent recites, in part, "wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more *arcs*," which I refer to herein as the "arc limitation." Ex. 1001 at 87:29-31 (emphasis added); Petition at 85. Based on my review, Petitioner and Dr. Mercier rely on Lisogurski's disclosure of a sensor with multiple LEDs and detectors for the claimed "semiconductor sources" and

“spatially separated detectors,” respectively. Petition at 30, 32, 37-39, 42; Ex. 1003 at ¶¶ 123-24, 128, 141-47, 157-58, 202. As Petitioner and Dr. Mercier recognize, however, Lisogurski does not disclose any arrangement of its LEDs or detectors, such as arranging its LEDs and detectors in “one or more arcs” as recited in claim 2. Petition at 57-61; Ex. 1003 at ¶¶ 202-12. For example, Dr. Mercier acknowledges that “Lisogurski does not explicitly teach arranging the LEDs and detectors in arcs.” Ex. 1003 at ¶ 210.

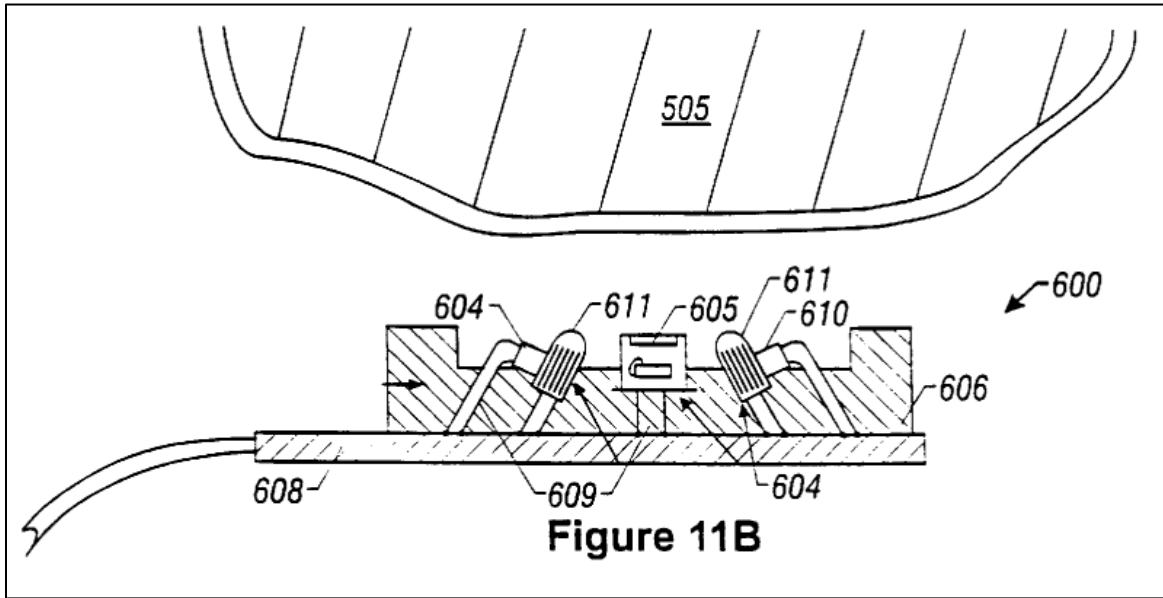
158. Petitioner and Dr. Mercier instead rely on Soller, arguing that Soller’s Figure 11A allegedly shows LEDs 604 and reference detectors 610 arranged in two respective arcs (which I refer to herein as the “alleged arc arrangement” in Soller) and that “[a] POSITA would have been motivated to combine the arrangement of detectors and LEDs in one or more ‘arcs’ disclosed in Soller into the wearable sensor described by Lisogurski” (Ex. 1003 at ¶ 209). Petition at 57-61; Ex. 1003 at ¶¶ 202-12.

159. Petitioner and Dr. Mercier’s argument includes the following annotated (in red and blue) version of Soller’s Figure 11A purporting to show this alleged arc arrangement in Soller:

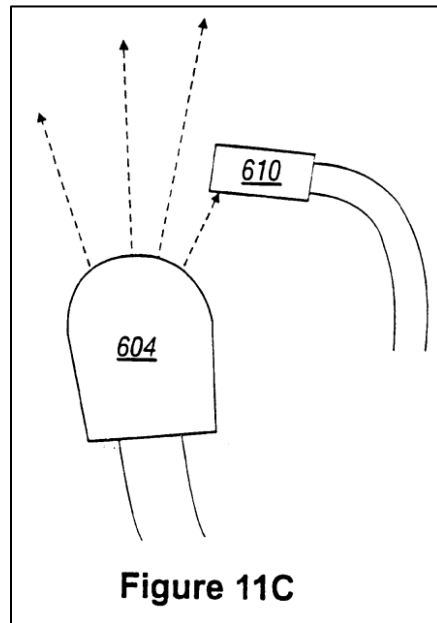


Petition at 57-60; Ex. 1003 at ¶ 202; Ex. 1030 at FIG. 11A (annotated).

160. Soller's Figures 11A-11C are related, as this embodiment depicted in Soller's Figure 11A (above) is also the same embodiment depicted in Soller's Figure 11B (below), and Soller's Figure 11C (below) depicts an alternate arrangement of the reference detectors 610 of Figures 11A-B. Ex. 1030 at FIGS. 11A-11C, 4:60-65, 17:36-50.



Ex. 1030 at FIG. 11B



Ex. 1030 at FIG. 11C

161. Petitioner and Dr. Mercier argue that before purportedly combining Lisogurski and Soller (i.e., before a POSITA would have modified Lisogurski to implement Soller's alleged arc arrangement from Figure 11A), a POSITA would

have first modified Soller to change the *reference* detectors 610 (depicted in Soller's embodiment in Figures 11A-11C) into *reflectance* detectors. Petition at 59-61 (arguing motivation "to modify Soller's [reference] detectors [610] depicted in Fig. 11A to be reflectance detectors" and then further arguing "motivat[ion] to modify Lisogurski to include ... detectors configured in one or more arcs, consistent with Soller's teachings"); Ex. 1003 at ¶¶ 202, 205-12 (arguing that a POSITA would have "modif[ied] Figure 11A of Soller such that the 'reference detectors [610]' ... could serve as 'reflectance detector(s)'" and then further arguing that a POSITA would have "combine[d] the arrangement of detectors ... in one or more "arcs" disclosed in Soller into the wearable sensor described by Lisogurski").

162. Petitioner and Dr. Mercier argue this preliminary modification of Soller's *reference* detectors 610 into *reflectance* detectors because the claimed "detectors" recited in the arc limitation and the relied-upon detectors in Lisogurski are *reflectance* detectors. Ex. 1001 at 86:45-64, 87:7-8, 87:27-31; Ex. 1027 at 17:39-42 (Lisogurski's "detector 318" is "for detecting the light that is reflected by or has traveled through the subject's tissue"); Petition at 19 (recognizing that the '455 Patent's invention includes: "[t]he output light is directed to a sample and then reflected/transmitted back where it is captured by detectors"), 23 (recognizing that Lisogurski teaches: "light is emitted by the LEDs ... , passes into a person's tissue, and is transmitted through/reflected back, where it is detected by a photodetector"),

37, 39-40, 42, 52; Ex. 1003 at ¶¶ 64, 85-86, 141-43, 147, 149-50, 210 (recognizing that the '455 Patent and Lisogurski involve detection of reflected light).

163. Petitioner and Dr. Mercier do not rely on Carlson for the arc limitation of claim 2. Petition at 57-61; Ex. 1003 at ¶¶ 202-12.

164. Lisogurski, Carlson, and Soller do not render obvious the arc limitation of claim 2, including because (i) Soller does not disclose this limitation, (ii) a POSITA would not have been motivated to modify Soller's reference detectors 610 to be reflectance detectors or modify Lisogurski's reflectance detectors based on Soller, and (iii) a POSITA would not have been motivated to implement Soller's modified arrangement in the Lisogurski/Carlson combination.

a) Previous IPRs Regarding Related Patents

165. I understand that certain portions of the Petition and Dr. Mercier's declaration rely on findings by the Board in prior IPR proceedings challenging patents related to the '455 Patent, including the '533-FWD and '484-FWD.

166. However, the arc limitation recited in claim 2 of the '455 Patent is not recited in the claims of either the '533 Patent or '484 Patent, and Petitioner and Dr. Mercier do not rely on the '533-FWD or '484-FWD in their analysis of claim 2. *See* Petition at 57-61; Ex. 1003 at ¶¶ 202-12. Therefore, to the extent that Petitioner and Dr. Mercier rely on the Board's findings in the '533-FWD and '484-FWD, those prior findings do not directly address the arc limitation in claim 2 of the '455 Patent.

b) Soller Does Not Disclose “the plurality of spatially separated detectors are located on one or more arcs”

167. Soller does not disclose “the plurality of spatially separated detectors are located on one or more arcs”—because Soller does not disclose an arc arrangement of *reflectance* detectors like the claimed “detectors.” Instead, the alleged arc arrangement that Petitioner and Dr. Mercier rely on in Soller involves *reference* detectors 610, which are different from the claimed “detectors.” Petition at 59-61; Ex. 1003 at ¶¶ 202-12

168. The claimed “detectors” recited in the arc limitation of claim 2 are *reflectance* detectors, as independent claim 1 (from which claim 2 depends) recites that “lenses” are “configured to ... deliver a lens output light to tissue” and that a “detection system” comprising the “plurality of detectors” is “configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal,” “wherein the output signal is indicative of one or more of the physiological parameters.” Ex. 1001 at 86:45-64, 87:7-8, 87:27-31. In other words, the claimed “detectors” receive reflected light from the sample. Based on my review, Petitioner and Dr. Mercier recognize this and rely on reflectance detectors in Lisogurski as allegedly constituting the claimed “detectors.” Petition at 19, 23, 37, 39-40, 42, 52; Ex. 1003 at ¶¶ 64, 85-86, 141-43, 147, 149-50, 210; Ex. 1027 at 17:39-42. Thus, the arc limitation of claim 2 requires *reflectance* “detectors” that are “located on one or more arcs.” Ex. 1001 at 86:45-64, 87:7-8, 87:27-31.

169. Soller does not disclose an arc arrangement of reflectance detectors as required by the arc limitation. The Petition and Dr. Mercier’s declaration rely on Soller’s Figure 11A embodiment, but, as depicted in the following annotated version of Figure 11A, this embodiment includes a single reflectance detector 605 (green) that is centrally located, not an arc arrangement of multiple reflectance detectors. Petition at 59-61; Ex. 1003 at ¶¶ 202, 205-06; Ex. 1030 at FIG. 11A, 17:36-60 (“Reflectance detector 605 is ... centrally located”).

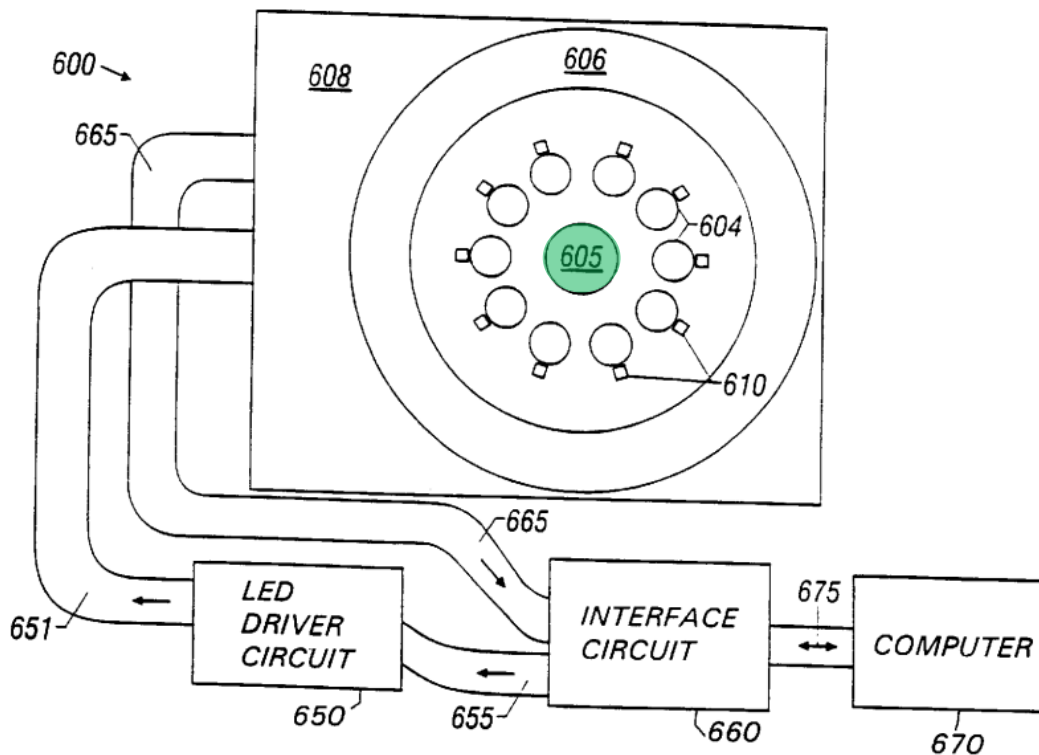


Figure 11A

Ex. 1030 at FIG. 11A (annotated)

170. Petitioner and Dr. Mercier appear to concede that Soller’s Figure 11A embodiment does not disclose an arc arrangement of reflectance detectors because

they argue that a POSITA would have modified this embodiment to meet the arc limitation (by changing reference detectors 610 into reflectance detectors). Petition at 59-61; Ex. 1003 at ¶¶ 205-08.

171. Dr. Mercier’s declaration (but not the Petition) also discusses Soller’s interior detectors 105 and exterior detectors 110, and Dr. Mercier suggests that Soller’s statement about “configured in a ring” purportedly applies to these detectors 105 and 110. Ex. 1003 at ¶¶ 202-03. I disagree. As depicted in the following annotated versions of Figures 5-6, Soller teaches that each interior detector 105 and exterior detector 110 (annotated in green) is centrally located – not that multiple detectors 105 and/or 110 are arranged in an arc.

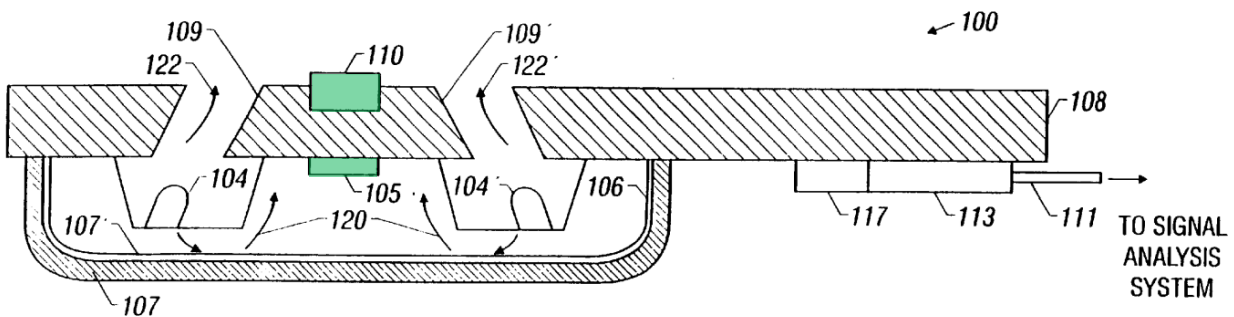


Figure 5

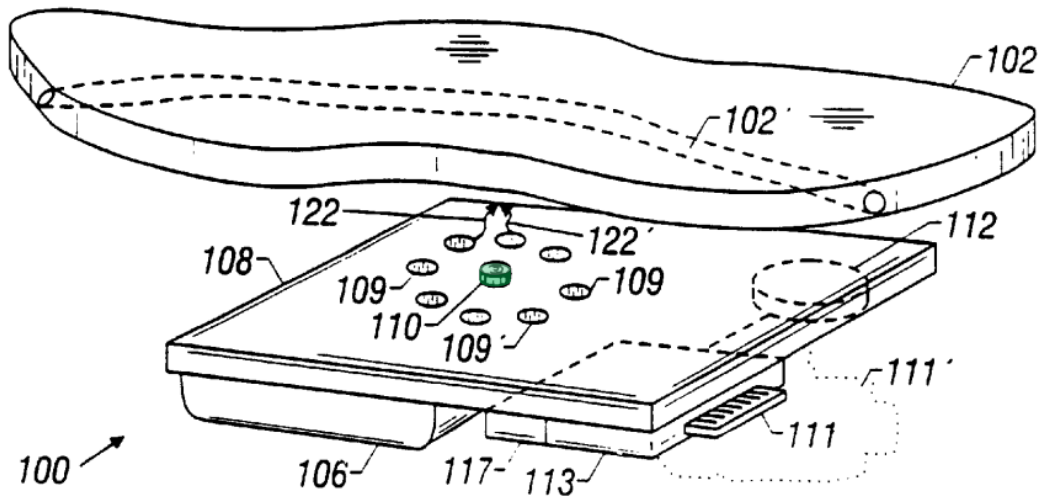


Figure 6

Ex. 1030 at FIGS. 5-6 (annotated); *see also* Ex. 1030 at 13:50-14:59

172. In contrast to detector 110, which Soller describes as a “reflection” detector, Soller does not likewise describe interior detector 105 as a reflection or reflectance detector. Ex. 1030 at 13:50-14:59. Additionally, Soller’s statement regarding “configured in a ring” relates to a ring 781 of fibers 780 in the embodiment depicted in Figures 12A-B and does not relate to detectors 105 and 110 in the embodiment depicted in Figures 5-6. Ex. 1030 at 18:38-41, FIGS. 12A-B, 5-6; Ex. 1003 at ¶ 203.

173. Dr. Mercier’s declaration (but not the Petition) also quotes portions of Soller regarding reference detector 155 and signal detector 157, and Dr. Mercier’s use of bold font and blue coloring suggest that Soller’s statements about “radially and symmetrically” disposed fibers apply to these detectors 155 and 157. Ex. 1003

at ¶ 202. I disagree. As depicted in the following annotated version of Figure 7, Soller teaches a single reference detector 155 and a single signal detector 157 (both green), not that multiple detectors 155 and/or 157 are arranged in an arc.

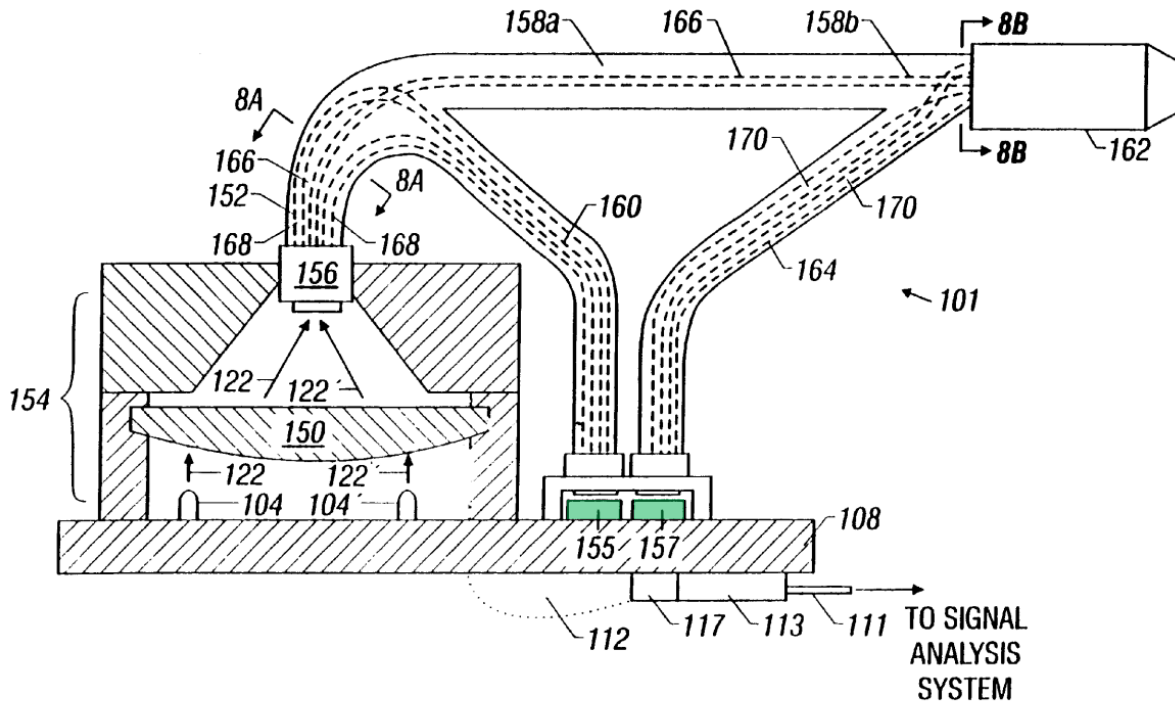


Figure 7

Ex. 1030 at FIG. 7 (annotated); *see also* Ex. 1030 at 16:8-32

174. Soller teaches that detector 155 is a reference detector, not a reflectance detector. Ex. 1030 at 16:8-21. Additionally, Soller’s statements about “radially and symmetrically” do not apply to detectors 155 and 157 – those statements relate to “fiber 166 surrounded by radially and symmetrically disposed reference fibers 168” and “signal fibers 170 ... radially and symmetrically disposed around ... delivery

fiber 166” as depicted in Figure 7, not any radial or symmetric arrangement of detectors 155 and/or 157. Ex. 1030 at 16:12-15, 16:25-27, FIG. 7; Ex. 1003 at ¶ 202.

175. Dr. Mercier’s declaration (but not the Petition) also quotes portions of Soller regarding reflectance detector 710 and reference detector 720. Ex. 1003 at ¶ 202. But as depicted in the following annotated version of Figures 12A-B, Soller teaches a single reflectance detector 710 and a single reference detector 720 (both green), not that multiple detectors 710 and/or 720 are arranged in an arc.

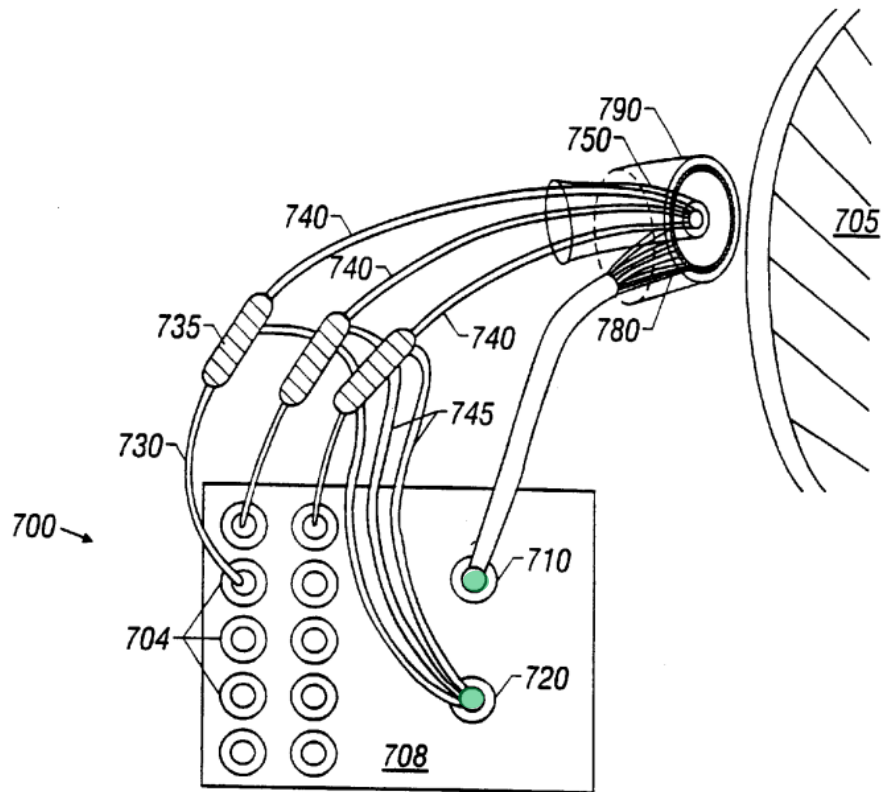


Figure 12A

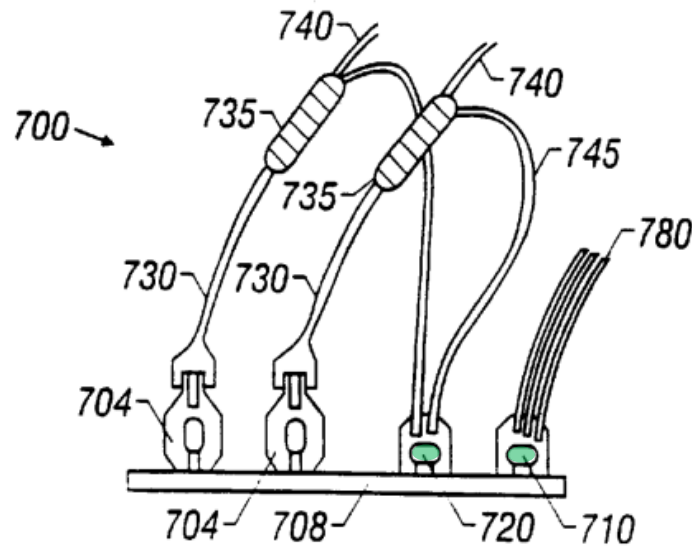


Figure 12B

Ex. 1030 at FIGS. 12A-B (annotated); *see also* Ex. 1030 at 18:24-25

Also, Soller teaches that detector 720 is a reference detector, not a reflectance detector. Ex. 1030 at 18:24-25.

176. In Soller, the reflectance detector that captures radiation reflected from the sample, such as the reflectance detectors discussed above, is centrally positioned and functions as a single reflectance detection element rather than as a plurality of detectors arranged along a curved or arc-shaped path. *See, e.g.*, Ex. 1030 at Figs. 3, 5, 6, 7, 10A, 10B, 11A, 11B, 12A, 12B. For example, Soller explains that “[r]eflectance detector 605 is preferably centrally located, e.g., center at about 4 mm from the optical axis of each LED 604.” Ex. 1030 at 17:54-56.

177. As discussed above, Petitioner and Dr. Mercier rely on Soller’s arrangement of reference detectors 610 depicted in Figure 11A for the arc limitation.

Petition at 57-61; Ex. 1003 at ¶¶ 202-12. However, Soller teaches, and a POSITA would have understood, that Soller's detectors 610 are *reference* detectors, which are different from *reflectance* detectors in the arc limitation. Ex. 1030 at 17:42-60. Reference detectors 610 are intended "to measure and correct for variations in the LED intensity due to temperature, aging, or electrical power source drifts," whereas reflectance detector 605 is intended to measure light reflected from sample 505. Ex. 1030 at 17:36-60; *see also* Ex. 1030 at 2:27-33 ("A detection system included in the device features a first optical [reflectance] detector and a plurality of second optical [reference] detectors. The first optical [reflectance] detector is configured to receive radiation from the sample. The plurality of second optical [reference] detectors is configured to receive radiation from each of the light sources."), 3:27-39 (similar). Reference detectors 610 are explicitly used to receive light directly from LEDs to monitor LED output for calibration purposes and are not configured to receive light reflected from the tissue like reflectance detector 605. Ex. 1030 at 17:45-48.

178. Based on the foregoing, Soller does not disclose the claim limitation of "the plurality of spatially separated detectors are located on one or more arcs." Indeed, based on my review, Petitioner and Dr. Mercier acknowledge this deficiency in Soller, since they instead rely on an alleged "modification" of Soller to meet this claim limitation. *See* Petition at 59-61; Ex. 1003 at ¶¶ 202, 205-08.

c) Petitioner and Dr. Mercier Do Not Show that a POSITA Would Have Been Motivated to Modify Soller's *Reference* Detectors 610 to Be *Reflectance* Detectors or Further Motivated to Modify Lisogurski's *Reflectance* Detectors Based on Soller

179. As discussed above, Petitioner and Dr. Mercier rely on Soller's reference detectors 610 in Figure 11A for the claimed arc arrangement, as these reference detectors 610 are the only detectors of Soller that the Petition mentions or depicts for the arc limitation. Petition at 57-61; Ex. 1003 at ¶¶202-212. As I explain above, these detectors 610 in Soller are reference detectors, not reflectance detectors like those in Lisogurski and those in the arc limitation. Ex. 1027 at 17:39-42; Petition at 23, 37, 39-40, 42, 52; Ex. 1003 at ¶¶ 85-86, 141-43, 147, 149-50, 210.

180. I understand that Petitioner and Dr. Mercier argue (1) that a POSITA would have modified Soller to change *reference* detectors 610 in the alleged arc arrangement in Figure 11A into *reflectance* detectors to match Lisogurski's teaching of *reflectance* detectors, and (2) that a POSITA would have purportedly modified Lisogurski's arrangement of *reflectance* detectors based on Soller's alleged arc arrangement of detectors 610 (as modified) to purportedly meet the arc limitation. Petition at 59-61; Ex. 1003 at ¶¶ 202, 205-12.

181. Petitioner and Dr. Mercier do not, with supporting evidence, show that a POSITA would have been motivated to modify Soller's *reference* detectors 610 to be *reflectance* detectors or that a POSITA would have purportedly used Soller's

alleged arc arrangement of detectors 610 to configure Lisogurski's *reflectance* detectors to meet the arc limitation. Petition at 59-61; Ex. 1003 at ¶¶ 202, 205-12.

182. The Petition addresses the alleged motivation to modify Soller's reference detectors 610 to instead be reflectance detectors in a single paragraph:

The "detectors" in Fig. 11A are "reference detectors" "mounted on the side of each LED to measure and correct for variations in...intensity," EX1030, 17:36- 50, but are still conventional photodiodes that a POSITA would have understood could be configured to serve as "reflectance detectors" to measure light received from the sample. EX1003 ¶¶205-11; EX1030, 17:42-60. It would have been obvious to modify Soller's detectors depicted in Fig. 11A to be reflectance detectors and a POSITA would have been motivated to make this modification as a routine design change. EX1003 ¶¶205-11. Soller itself directly teaches modifying the arrangement of detectors. EX1030, 17:42-49 ("Fig. 11C shows an alternate mounting position for reference detectors 610, which allows more light to reach reference detectors 610"); *see also id.*, 18:47-58 ("Hematocrit measuring device 700 can be modified").

Petition at 60-61; *see also* Ex. 1003 at ¶¶ 205-08.

183. Petitioner and Dr. Mercier argue that Soller's reference detectors 610 are "conventional photodiodes" that a POSITA would have understood "could [be configured to] serve as 'reflectance detector[s].'" Petition at 60 (citing Ex. 1030 at 17:42-60); Ex. 1003 at ¶¶ 205-06. I disagree. Soller does not teach that reference detectors 610 can be modified or serve as reflectance detectors, much less provide any motivation for a POSITA to make such a change. Ex. 1030 at 17:42-60.

184. Even assuming that Petitioner and Dr. Mercier are correct that Soller's reference detectors 610 "could [be configured to] serve as 'reflectance detector[s].'"

they do not explain *why* one would do so. Petition at 60; Ex. 1003 at ¶ 206. That is, even if reference detectors 610 *could* be modified to be reflectance detectors, Petitioner and Dr. Mercier do not explain *why* a POSITA would do so. Petition at 60; Ex. 1003 at ¶ 206. As I explain in Section X.A.2.d below, a POSITA would not have been motivated to do so, at least because Soller’s embodiment with reference detectors 610 already includes a reflectance detector 605 and because this modification would result in that embodiment containing no reference detectors, which is inconsistent with Soller’s teachings of using both reference and reflectance detectors. Ex. 1030 at FIG. 11A, 17:42-60, 2:27-33, 3:27-32, 16:8-32, 18:24-25.

185. The Petition also argues that modifying Soller’s reference detectors 610 to be reflectance detectors would have been a “routine design change.” Petition at 60 (citing only Ex. 1003 at ¶¶ 205-11). The potentially relevant paragraphs of Dr. Mercier’s declaration (¶¶ 206-08) similarly argue that the alleged modification would have been a “straightforward substitution” and “straightforward design modification,” and Dr. Mercier asserts a few changes that a POSITA purportedly “could” or “can” make: “reference detectors [610] can be moved to the interior of the LEDs”; “the reflectance detector(s) could also be arranged in a different position, including to be further away from the LEDs”; “the reflectance detectors can be arranged in a circular pattern surrounding the LEDs.” Ex. 1003 at ¶¶ 206-08. Petitioner and Dr. Mercier do not explain what the alleged “routine design change”

(or “straightforward [substitution or design modification]”) would be, including what changes would be made to what components in the embodiment shown in Figures 11A-B. Petition at 60; Ex. 1003 at ¶¶ 206-08. For example, Petitioner and Dr. Mercier do not explain specifically where and how detectors 610 would be mounted, what would happen to existing reflectance detector 605, how LEDs 604 would be changed (e.g., angle), or how the embodiment would work without any remaining reference detectors. Petition at 60; Ex. 1003 at ¶¶ 206-08.

186. I disagree with Petitioner and Dr. Mercier’s argument that modifying Soller’s reference detectors 610 to instead be reflectance detectors would be a mere “routine design change,” “straightforward substitution,” and “straightforward design modification.” Petition at 60; Ex. 1003 at ¶¶ 206-08. This alleged modification would change the structure and function of the relied-upon embodiment (device 600) depicted in Soller’s Figures 11A-B. For example, Soller’s teaches a structure of device 600 in which “[r]eference detectors 610 are mounted on the side of each LED [604],” with the associated function “to measure and correct for variations in the LED intensity,” which involves reference detectors 610 receiving light from LEDs 604 directly (not reflected from sample 505). Ex. 1030 at 17:36-48, FIGS. 11A-B. Soller further teaches a structure of device 600 in which LEDs 604 are mounted “at an angle” around a “centrally located” reflectance detector 605, with the associated

function of reflectance detector 605 receiving reflected light from sample 505 that is emitted by LEDs 604. Ex. 1030 at 17:36-43, 17:51-56, FIGS. 11A-B.

187. A POSITA would have understood that Petitioner and Dr. Mercier's proposed modification of changing reference detectors 610 to be reflectance detectors would have altered the structure and function of reference detectors 610, at least because detectors 610 would then detect light reflected from sample 505 rather than directly from LEDs 604, and this would require changing the mounting and location of detectors 610 such that they no longer receive light directly from LEDs 604. Ex. 1030 at 17:36-48, FIGS. 11A-B. A POSITA would have understood that the proposed modification would necessitate additional changes to structure and function, including: changing the mounting angle of LEDs 604 depending on the location and mounting of the modified detectors 610; removing or changing the location of existing reflectance detector 605 depending on the location and mounting of the modified detectors 610, the related location and mounting of LEDs 604, and the redundancy of reflectance detector 605 and modified detectors 610; and modifying device 600—since the proposed modification would result in no remaining reference detectors in device 600—to add one or more new reference detectors (and/or convert reflectance detector 605 into a reference detector), including locating and mounting the new reference detector(s) appropriately in

relation to the modified LEDs 604 in order to measure and correct for variations in LED intensity of LEDs 604. *See* Ex. 1030 at 17:36-60, FIGS. 11A-B.

188. The Petition and Dr. Mercier also argue that “Soller itself directly teaches modifying the arrangement of detectors.” Petition at 60-61 (citing Ex. 1030 at 17:42-49, 18:47-58); Ex. 1003 at ¶ 206 (same). Even assuming that this assertion by Petitioner and Dr. Mercier regarding “modifying the arrangement of detectors” is correct, modifying the *arrangement* of detectors is not equivalent to modifying the *type* of detector. Soller does not teach modifying the *type* of detector, including the proposed modification of converting reference detectors 610 into reflectance detectors, which would result in no remaining reference detectors in device 600. Ex. 1030 at 17:42-43, FIG. 11A.

189. Petitioner and Dr. Mercier’s two citations to Soller for their assertions about “modifying the arrangement of detectors” do not teach or suggest converting reference detectors 610 into reflectance detectors. *See* Petition at 60-61 (citing Ex. 1030 at 17:42-49, 18:47-58); Ex. 1003 at ¶ 206 (same). Their first citation is for Soller’s teaching that “FIG. 11C shows an alternate mounting position for reference detectors 610 which allows more light to reach reference detectors 610.” Petition at 60-61 (citing and quoting Ex. 1030 at 17:42-49 regarding “Fig. 11C”); Ex. 1003 at ¶ 206 (same). But this does not teach that reference detectors 610 can be modified to be reflectance detectors. Rather, the cited disclosure merely teaches that reference

detectors 610 can be mounted in different ways relative to LEDs 604, which relates to improving the performance of detectors 610 *as reference detectors* by increasing the amount of light that detectors 610 receive directly from LEDs 604. Ex. 1030 at 17:42-50, FIG. 11C. A POSITA would have understood that a reference detector 610 arranged as shown in Figure 11C *cannot* serve as a reflectance detector because it receives light directly from LED 604 before that light reaches sample 505 and thus its detection of reflected light from sample 505 would be contaminated. Ex. 1030 at 17:42-50, FIG. 11C.

190. Petitioner and Dr. Mercier's second citation for their assertions about "modifying the arrangement of detectors" is to Soller's teaching that "Hematocrit measuring device 700 can be modified." Petition at 60-61 (citing and quoting Ex. 1030 at 18:47-58); Ex. 1003 at ¶ 206 (same). This does not teach that reference detectors 610 can be modified to be reflectance detectors, as this cited disclosure relates to a different embodiment of Soller (i.e., device 700 in Figures 12A-B), not the relevant embodiment of device 600 in Figures 11A-B that contains reference detectors 610. *Compare* Ex. 1030 at 18:18-19, 18:47-58, FIGS. 12A-B *with* Ex. 1030 at 17:36-38, FIGS. 11A-B. While Petitioner and Dr. Mercier cite this teaching that Soller's "device 700 can be modified," this teaching does not mention or involve modification of any detector, much less conversion of a reference detector into a reflectance detector. Ex. 1030 at 18:47-58.

191. Petitioner and Dr. Mercier do not specifically explain *how* a POSITA would have modified Soller's device 600 to implement their proposed modification. Petition at 59-61; Ex. 1003 at ¶¶ 202-12. For example, Soller teaches that reference detectors 610 are mounted relative to LEDs 604 so that reference detectors 610 receive light directly from LEDs 604 (not reflected light from sample 505) and that LEDs 604 and centrally-located reflectance detector 605 are located and angled appropriately for reflectance detector 605 to receive reflected light from sample 505. Ex. 1030 at FIGS. 11A-B, 17:36-60. A POSITA would have understood that changing reference detectors 610 to be reflectance detectors would have affected and necessitated changes to these aspects of Soller's device 600.

192. Petitioner and Dr. Mercier do not address how a POSITA would have done so. Petition at 59-61; Ex. 1003 at ¶¶ 202-12. For example, assuming that a POSITA sought to convert reference detectors 610 into reflectance detectors, Petitioner and Dr. Mercier do not address: the changes needed regarding the mounting and location of detectors 610; the resulting redundancy between the converted detectors 610 and existing reflectance detector 605 or any changes to detector 605; the addition of new reference detectors given that the modification to detectors 610 would result in no remaining reference detectors in device 600; and the relative location and angles of LEDs 604, converted detectors 610, and existing

reflectance detector 605. Petition at 59-61; Ex. 1003 at ¶¶ 202-12; Ex. 1030 at FIGS. 11A-B, 17:36-60.

193. Based on the foregoing analysis, Petitioner and Dr. Mercier fail to show that a POSITA would have been motivated to modify *reference* detectors 610 in Soller’s alleged arc arrangement in Figure 11A to instead be *reflectance* detectors. Petitioner and Dr. Mercier therefore fail to show that Soller renders obvious the arc limitation with respect to the *reflectance* “detectors.” Petition at 59-61; Ex. 1003 at ¶¶ 202-12.

194. Petitioner and Dr. Mercier also fail to show that a POSITA would have modified the arrangement of Lisogurski’s *reflectance* detectors based on Soller to meet the arc limitation. Petitioner and Dr. Mercier make a two-part argument for combining Soller and Lisogurski to meet the arc limitation with respect to the claimed “detectors”—i.e., that (1) Soller would have been modified to change *reference* detectors 610 in the alleged arc arrangement in Figure 11A into *reflectance* detectors and (2) then Lisogurski would have been modified to arrange its relied-upon *reflectance* detectors based on Soller’s alleged arc arrangement. Petition at 59-61; Ex. 1003 at ¶¶ 202-12. Petitioner and Dr. Mercier’s two-part argument recognizes that their proposed modification of Lisogurski to implement Soller’s alleged arc arrangement is predicated on first modifying Soller’s *reference* detectors 610 to be *reflectance* detectors. Petition at 59-61; Ex. 1003 at ¶¶ 202-12.

But for at least the reasons discussed above, Petitioner and Dr. Mercier fail to show motivation for part (1) of their argument, and thus part (2) also fails. That is, Petitioner and Dr. Mercier fail to show that a POSITA would have used Soller's alleged arc arrangement of detectors 610 in Figure 11A to arrange Lisogurski's *reflectance* detectors in an arc because, as discussed above, they fail to show that a POSITA would have modified Soller's detectors 610 to be *reflectance* detectors. Petition at 59-61; Ex. 1003 at ¶¶ 202-12.

d) A POSITA Would Not Have Been Motivated to Modify Soller's *Reference* Detectors 610 to Be *Reflectance* Detectors or Further Motivated to Modify Lisogurski's *Reflectance* Detectors Based on Soller

195. A POSITA would not have been motivated to modify Soller's reference detectors 610 to be reflectance detectors because Soller teaches that the device 600 already includes a reflectance detector 605. Ex. 1030 at 17:42-43, FIGS. 11A-B. Dr. Mercier recognizes that "Soller teaches ... the 'reflectance detector [605]' for receiving light transmitted/reflected from the sample." Ex. 1003 at ¶ 205 (citing Ex. 1030 at 17:42-60). A POSITA would have understood that if reference detectors 610 were converted into reflectance detectors, which would measure light reflected from sample 505, then those modified detectors 610 would be redundant to the existing reflectance detector 605 that already performs that same function of measuring light

reflected sample 505. Ex. 1030 at 17:36-43, FIGS. 11A-B, 2:30-31. This modification and redundancy would be unnecessary and inefficient.

196. For example, a POSITA would have understood based on Soller that the existing reflectance detector 605 is sufficient for measuring light reflected from sample 505 and that additional reflectance detectors are not needed. Modifying reference detectors 610 to be reflectance detectors would create unnecessary duplication of parts, costs, and functions. Because Soller already teaches reflectance detector 605, a POSITA would not have understood that the proposed modification of reference detectors 610 to add more reflectance detectors would have created any advantages or benefits.

197. Petitioner and Dr. Mercier do not address the existing reflectance detector 605 in Soller or why a POSITA would have purportedly been motivated to convert reference detectors 610 into reflectance detectors when Soller already teaches reflectance detector 605. Petition at 59-61; Ex. 1003 at ¶¶ 205-08. For example, Petitioner and Dr. Mercier do not address or explain:

- the fact that detectors 610, if modified to be reflectance detectors, would be redundant to existing reflectance detector 605. Petition at 59-61; Ex. 1003 at ¶¶ 205-08;

- if or how existing reflectance detector 605 would be modified as part of their proposed modification of reference detectors 610 into reflectance detectors. Petition at 59-61; Ex. 1003 at ¶¶ 205-08;
- differences (e.g., functional differences) between the proposed modified detectors 610 (i.e., detectors 610 modified to be reflectance detectors) and existing reflectance detector 605. Petition at 59-61; Ex. 1003 at ¶¶ 205-08;
- any advantage or benefit of Soller's device 600 containing both the proposed modified detectors 610 (i.e., detectors 610 modified to be reflectance detectors) and existing reflectance detector 605. Petition at 59-61; Ex. 1003 at ¶¶ 205-08.

198. A POSITA would not have been motivated to modify Soller's reference detectors 610 to be reflectance detectors because this would result in device 600 containing no reference detectors, which is contrary to Soller's teachings and goals. Ex. 1030 at 17:36-48, FIGS. 11A-B. Soller is directed to hematocrit measuring devices that contain both reflectance detectors and reference detectors, with the reflectance detectors configured to receive and measure light reflected from a sample and the reference detectors configured to receive and measure light from LEDs to account for their differences:

- Ex. 1030 at 2:27-33 ("A detection system included in the device features a first optical [reflectance] detector and a plurality of second

optical [reference] detectors. The first optical [reflectance] detector is configured to receive radiation from the sample. The plurality of second optical [reference] detectors is configured to receive radiation from each of the light sources”);

- Ex. 1030 at 3:27-32 (“detection system includes a first optical [reflectance] detector ... for receiving radiation from the sample” and “a second optical [reference] detector ... for receiving radiation directly from each of the light sources”);
- Ex. 1030 at 13:50-14:13 (“device 100 includes interior [reference] detectors 105 and exterior [reflectance] detectors 110”; “radiation is ... reflected by the sample towards the exterior reflection detector 110 for detection”; “interior [reference] detector 105 monitors the optical output emitted from the LEDs”), FIGS. 5-6;
- Ex. 1030 at 16:8-32 (“reference detector 155” and “signal detector 157”), FIG. 7;
- Ex. 1030 at 16:61-17:5 (“device 300 includes interior [reference] detector 350 and exterior [reflectance] detector 330”; “interior [reference] detector 350 monitors the optical output emitted from the LEDs”);

- Ex. 1030 at 17:42-48 (“Device 600 includes a reflectance detector 605 and a series of reference detectors 610”; “Reference detectors 610 ... measure ... variations in the LED intensity”), FIGS. 11A-B;
- Ex. 1030 at 18:24-25 (“Device 700 includes a reflectance detector 710 and a reference detector 720”), FIGS. 12A-B;
- Ex. 1030 at 18:66-67 (“Device 800 includes a reflectance detector 805 and two reference detectors 810”), 19:17-27 (“radiation is ... reflected by the sample towards reflectance detector 805”; “reference detector 810 monitors the optical output emitted from LEDs 804”), FIGS. 13A-B;
- Ex. 1030 at 23:14-36 (“A device for determining blood hematocrit ... comprising a first optical [reflectance] detector and a plurality of second optical [reference] detectors, the first optical [reflectance] detector being configured to receive radiation from the sample ... and the plurality of second optical [reference] detectors each being configured to detect radiation directly from one of the light sources”).

199. Soller teaches that its purported invention includes reference detectors for measuring and accounting for variations in LED intensity when calculating reflected light measured by the reflectance detector(s):

- Ex. 1030 at 2:58-63 (“the radiation detected by the plurality of second [reference] detectors can be ... used to determine a reference spectrum which ... is used to calculate the reflection spectrum. Inclusion of the reference spectrum allows variations in the intensity of each light source to be taken into account.”);
- Ex. 1030 at 7:26-29 (“The absorption spectrum ... can be calculated by taking the log of a reference spectrum ... divided by the sample reflection spectrum”);
- Ex. 1030 at 14:7-13 (“Radiation detected by the interior [reference] detector is used to determine a reference spectrum which allows intensity variations from the various LEDs to be accounted for. The actual reflectivity spectrum is calculated by taking the ratio of the reflected radiation, as measured with the exterior reflection detector, to the reference spectrum, as measured with the interior [reference] detector”);
- Ex. 1030 at 17:1-5 (“Radiation detected by the interior [reference] detector is used to determine a reference spectrum which allows intensity variations from the various LEDs to be accounted for”);

- Ex. 1030 at 17:45-48 (“Reference detectors 610 ... measure and correct for variations in the LED intensity due to temperature, gaining, or electrical power source drifts”);
- Ex. 1030 at 19:4-7 (“Reference detectors 810 ... measure and correct for variations in the LED intensity due to temperature, aging or electrical power source drifts”).

For example, Soller’s embodiment that Petitioner and Dr. Mercier rely upon for the arc limitation (device 600 depicted in Figure 11A) contains both “a reflectance detector 605 and ... reference detectors 610,” so that reference detectors 610 can “measure and correct for variations in the LED intensity due to temperature, gaining, or electrical power source drifts.” Ex. 1030 at 17:36-48.

200. Petitioner and Dr. Mercier’s proposed modification to Soller would result in device 600 containing only reflectance detectors and no reference detectors. That is, Petitioner and Dr. Mercier argue that Soller would have been modified to change reference detectors 610 in device 600 into reflectance detectors. Petition at 59-61 (“The ‘[reference] detectors [610]’ in Fig. 11A ... could be configured to serve as ‘reflectance detectors’ to measure light received from the sample. ... It would have been obvious to modify Soller’s [reference] detectors [610] depicted in Fig. 11A to be reflectance detectors” (citing Ex. 1030 at 17:42-60)); Ex. 1003 at ¶¶ 205-06. Soller does not disclose any other reference detectors in device 600 besides

reference detectors 610. Ex. 1030 at 17:36-18:17, FIGS. 11A-B. If Soller's device 600 is modified to change reference detectors 610 into reflectance detectors, as Petitioner and Dr. Mercier propose, then this modified version of device 600 would not contain any reference detectors.

201. Because Petitioner and Dr. Mercier's proposed modification to Soller's detectors 610 would result in the device 600 containing no reference detectors, this modification is inconsistent with Soller's invention, which is directed to devices that include reference detectors. Ex. 1030 at 2:27-33, 3:27-32, 13:50-14:13, FIGS. 5-6, 16:8-32, FIG. 7, 16:61-17:5, 17:42-48, FIGS. 11A-B, 18:24-25, FIGS. 12A-B, 18:66-67, 19:17-27, FIGS. 13A-B, 23:14-36. Petitioner and Dr. Mercier do not identify any teachings in Soller that only use reflectance detector(s) and zero reference detectors (which is the result of their proposed modification). Petition at 59-61; Ex. 1003 at ¶¶ 202-12.

202. Additionally, their proposed modification would result in the device 600 containing no reference detectors, which is inconsistent with and detracts from Soller's stated goal of using reference detectors to account for variation in LED intensity to more accurately calculate reflected light from a sample. Ex. 1030 at 2:58-63, 7:26-29, 14:7-13, 17:1-5, 17:45-48, 19:4-7. Petitioner and Dr. Mercier do not explain how Soller's device 600 would achieve this stated goal if modified as

proposed to change all of device 600's reference detectors 610 into reflectance detectors. Petition at 59-61; Ex. 1003 at ¶¶ 202-12.

203. A POSITA would not have been motivated to make Petitioner and Dr. Mercier's proposed modification, since that modification is inconsistent with Soller's teachings and goals. That is, based on Soller's teachings and goals regarding inclusion of reference detectors to account for variation in LED intensity, and because Petitioner and Dr. Mercier's proposed modification of Soller would change reference detectors 610 into reflectance detectors and leave device 600 with no remaining reference detector, a POSITA would not have been motivated make that proposed modification of Soller.

204. Additionally, a POSITA would not have been motivated to modify Soller's reference detectors 610 to be reflectance detectors because this would result in incompatibilities and inoperability in device 600. A POSITA would have understood that modifying reference detectors 610 to be reflectance detectors would be incompatible with how those detectors 610 are disposed in device 600. Soller teaches that detectors 610 are located and mounted relative to LEDs 604 to receive light directly from LEDs 604. Specifically, Soller teaches, as shown in Figures 11A-B, that "[r]eference detectors 610 are mounted on the side of each LED to measure ... the LED intensity," and also teaches, as shown in Figure 11C, "an alternate mounting position for references detectors 610 which allows more light to reach

reference detectors 610” from LEDs 604. Ex. 1030 at FIGS. 11A-C, 17:42-50. Given this positioning of detectors 610 in device 600, detectors 610 cannot function as reflectance detectors because detectors 610 receive light directly from LEDs 604 before that light is transmitted to and reflected from sample 505.

205. A POSITA would have understood that if detectors 610 were converted into reflectance detectors, their detection and measurement of reflected light from sample 505 would be contaminated by their reception of light directly from LEDs 604 (also known as spillover or interference). If detectors 610 were modified to be reflectance detectors, Soller does not teach any means of preventing such spillover or interference with respect to the modified detectors 610 (e.g., filters or spatial separation from LEDs 604). Thus, if reference detectors 610 were modified to be reflectance detectors, then those modified detectors 610 would be incompatible with their positioning (location and mounting) in device 600, which would preclude detectors 610 from properly and accurately functioning as reflectance detectors.

206. Also, modifying reference detectors 610 to be reflectance detectors would render device 600 inoperable for its intended purpose of measuring reflected light from sample 505, as the modified detectors 610 would not be capable of accurately measuring such reflected light for the same reasons discussed above regarding incompatibility. That is, the positioning of detectors 610 in device 600 precludes detectors 610 from properly and accurately functioning as reflectance

detectors, so Petitioner and Dr. Mercier’s proposed modification of changing detectors 610 into such reflectance detectors would render those detectors 610 and device 600 inoperable for their intended purpose.

207. Petitioner and Dr. Mercier do not address these incompatibility and inoperability issues. For example, Petitioner and Dr. Mercier do not acknowledge or address the fact, as explained above, that detectors 610 cannot function as reflectance detectors because they are specifically positioned in device 600 to receive light directly from LEDs 604. Petition at 59-61; Ex. 1003 at ¶¶ 205-08. Petitioner and Dr. Mercier do not address whether a POSITA would have modified the positioning of those detectors 610, and if so, how. Petition at 59-61; Ex. 1003 at ¶¶ 205-08.

208. Dr. Mercier’s declaration includes an assertion that “[i]t would have been readily apparent to a POSITA reading Soller that the reflectance detector(s) could also be arranged in a different position, including to be further away from the LEDs,” but this assertion merely refers to what “could” be done, not that a POSITA *would* have made this change. Ex. 1003 at ¶ 207. Also, this assertion in Dr. Mercier’s declaration is unclear as to what specific “reflectance detector(s)” it is referring to, and this assertion lacks any cited support or explanation. Ex. 1003 at ¶ 207.

209. For at least the reasons I discuss above, a POSITA would not have been motivated to modify *reference* detectors 610 in Soller’s alleged arc arrangement in Figure 11A to instead be *reflectance* detectors, as Petitioner and Dr. Mercier argue.

Soller thus does not render obvious the arc limitation with respect to the *reflectance* “detectors.”

210. Additionally, because a POSITA would not have modified *reference* detectors 610 in Soller’s alleged arc arrangement in Figure 11A to be *reflectance* detectors to begin with, a POSITA also would not have been motivated to use that alleged arc arrangement of detectors 610 in Soller to arrange Lisogurski’s *reflectance* detectors, as Petitioner and Dr. Mercier further argue. That is, since Soller’s alleged arc arrangement involves *reference* detectors 610, and a POSITA would not have modified those *reference* detectors 610 to be *reflectance* detectors, a POSITA would not have used that alleged arrangement of (unmodified) *reference* detectors 610 to arrange Lisogurski’s *reflectance* detectors. Indeed, Petitioner and Dr. Mercier recognize that a POSITA would not be motivated to modify the arrangement of Lisogurski’s *reflectance* detectors based on Soller’s arrangement of (unmodified) *reference* detectors 610, as Petitioner and Dr. Mercier first argue an alleged modification of Soller’s *reference* detectors 610 into *reflectance* detectors before then arguing the alleged modification of Lisogurski based on Soller. Petition at 59-61; Ex. 1003 at ¶¶ 205-12.

e) Petitioner and Dr. Mercier Do Not Show that a POSITA Would Have Been Motivated to Implement Soller's Alleged Arc Arrangement in Lisogurski to Meet the Arc Limitation

211. For the arc limitation recited in claim 2, Petitioner and Dr. Mercier argue that “[a] POSITA would have been motivated to combine the arrangement of detectors and LEDs in one or more “arcs” disclosed in Soller into the wearable sensor described by Lisogurski.” Ex. 1003 at ¶¶ 202-212; Petition at 56-61.

212. Dr. Mercier's and Petitioner's discussion of Soller's alleged arc arrangements consists largely of restating what Soller discloses and asserting that the same arrangement could be applied to Lisogurski. *See* Ex. 1003 at ¶¶ 202-212; Petition at 56-61. Petitioner and Dr. Mercier fail to identify any teaching in Lisogurski suggesting the need for such an arrangement, nor any recognized design problem that Soller uniquely solves in the Lisogurski context. *See* Ex. 1003 at ¶¶ 202-212; Petition at 56-61.

213. Petitioner and Dr. Mercier do not show that a POSITA would have been motivated to implement Soller's alleged arc arrangement of LEDs and detectors to arrange Lisogurski's sensor's LEDs and detectors.

i. Soller and Lisogurski Are Directed to Fundamentally Different Measurement Problems and Systems

214. Soller is directed to hematocrit measurement, not oximetry. Soller explains: “Hematocrit is the volume percent of red blood cells in a blood sample.”

Ex. 1030 at Abstract, 1:19-20. Soller states that “[t]he invention provides an optical and mathematical method to measure hematocrit with increased accuracy relative to other methods, e.g., impedance and oximetric methods.” Ex. 1030 at 5:42-45.

215. Soller distinguishes its invention from conventional oximetry methods, stating “[a]ll of the reported optical techniques are variations on oximetric methods where hematocrit is measured using only the concentrations of oxygenated and deoxygenated hemoglobin.” Ex. 1030 at 1:36-40. Soller further notes that those concentrations are measured “using 2 to 4 wavelengths of light in the near-infrared region of the hemoglobin Spectrum,” underscoring the limited-wavelength nature of the oximetry approaches. Ex. 1030 at 1:41-44.

216. Soller emphasizes that its method is different from oximetry: the present invention provides a “new optical method, which measures blood hematocrit by quantifying a plurality of red blood cell constituents.” Ex. 1030 at 1:49-51. Hematocrit in Soller is determined by “processing the optical spectrum with a mathematical model” that relies on a “method includ[ing] irradiating blood with optical radiation having a selected range of optical wavelengths to produce an optical spectrum.” Ex. 1030 at 1:52-62. Soller teaches that accurate hematocrit measurement requires explicitly accounting for additional hemoglobin species and other red-blood-cell constituents beyond oxygenated and deoxygenated hemoglobin. Ex. 1030 at 5:33-42. Soller explains that “other forms of hemoglobin are also present

in the red blood cell, including methemoglobin, carboxyhemoglobin and sulfhemoglobin,” and that the red blood cell includes other optically relevant components such as “the nucleus and cellular membranes.” Ex. 1030 at 5:33-42. Soller then states: “[t]o accurately measure hematocrit, not only must these additional forms of hemoglobin be accounted for, but so must the remaining 10% of the cellular components, the nucleus and cell membranes, which do not contain hemoglobin.” Ex. 1030 at 5:38-42.

217. Lisogurski, in contrast, is a pulse oximetry system that estimates blood oxygen saturation by exploiting the known absorption differences between oxyhemoglobin (HbO_2) and deoxyhemoglobin (Hb). Ex. 1027 at 4:42-48, 24:58-25:5. Lisogurski explains that “[r]ed and infrared (IR) wavelengths may be used because it has been observed that highly oxygenated blood will absorb relatively less red light and more IR light than blood with a lower oxygen saturation.” Ex. 1027 at 4:42-48, 24:58-25:5. Lisogurski further teaches that “[b]y comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen saturation of hemoglobin in arterial blood.” Ex. 1027 at 4:48-51. Lisogurski’s measurement principle depends on a two-channel comparison tied directly to HbO_2/Hb absorption physics. Ex. 1027 at 4:48-56.

218. Consistent with that physiological model, Lisogurski relies on the conventional two-wavelength ratio-of-ratios computation, which assumes that

oxygen saturation can be inferred from the relative pulsatile changes measured at two wavelengths. Lisogurski expressly states that oxygen saturation may be computed “using two wavelengths of light and a ratio-of-ratios calculation.” Ex. 1027 at 4:52-56. Lisogurski also confirms that “[r]atio-of-ratio calculations are common calculations in pulse oximeters” and “may use IR and red ... to determine oxygen saturation.” Ex. 1027 at 45:6-9. “The ratio-of-ratio calculation term may be approximated as:

$$\frac{\left(\frac{Red_{max} - Red_{min}}{Red_{mean}} \right)}{\left(\frac{IR_{max} - IR_{min}}{IR_{mean}} \right)}$$

where terms relate to the maximum, minimum, and mean amplitudes of the associated signals.” Ex. 1027 at 45:11-21. A POSITA would therefore understand that Lisogurski is not designed for spectral measurements across many wavelengths, as disclosed by Soller (Ex. 1030 at 5:48-63), but instead is built around a deliberately simplified, standard dual-wavelength ratio-of-ratios model tailored specifically to estimating blood oxygen saturation. Ex. 1027 at 4:52-56, 45:6-21.

219. A POSITA would understand that Soller is not merely adding incremental features to an oximetric method, but is departing from the core assumption that HbO₂/Hb alone can support accurate hematocrit measurement. Ex. 1030 at 5:33-54. Soller's solution is not a ratio-of-ratios approach but a broader spectral-modeling technique, requiring a larger wavelength set and a multivariate calibration framework. Ex. 1030 at 5:48-63.

220. Soller states that “[t]he invention quantifies these additional blood cell components both by using a larger set of wavelengths in the measurement.” Ex. 1030 at 5:48-51. Soller further indicates that the measurement may use “7 or more wavelengths, to record optical spectra of blood.” Ex. 1030 at 5:55-63. Soller discloses that its LEDs collectively cover a broad spectral range, stating that “LEDs 310 are commercially available and uniformly span the 500-1100 nm range with emission band widths of about 30-100 nm for each LED.” Ex. 1030 at 17:31-33. Soller explains that “by using a larger set of wavelengths for analysis, the method compensates for variations in blood volume by accounting for factors relating to blood volume.” Ex. 1030 at 5:51-54. Soller emphasizes that “[t]o accurately measure blood hematocrit, it is important that the range of optical wavelengths chosen includes the absorption and scattering affects of the plurality of red blood cell constituents,” “such as the nucleus and cell membrane.” Ex. 1030 at 6:33-41.

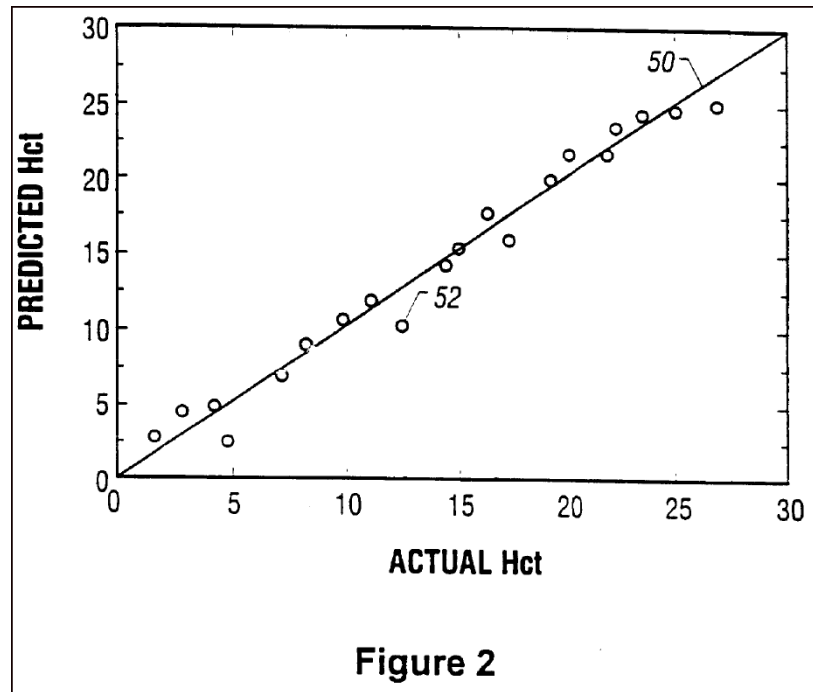
221. Soller also relies on a different mathematical model than Lisogurski's ratio-of-ratios approach:

The mathematical model relates actual blood hematocrit to optical data. The model is generated by taking optical spectra for a range of wavelengths affected by the plurality of red blood cell constituents from a number of samples at known hematocrit values, and then processing the spectra and the hematocrit values with a multivariate calibration procedure, e.g., a Partial Least Squares (PLS) fitting algorithm. The model is then used to determine the blood hematocrit of a blood sample, e.g., tissue containing blood, by measuring a reflection or transmission spectrum from the blood, and then comparing the spectrum to the model. Multivariate calibration procedures incorporate information from a variety of chemical species and physical processes without having to measure separately the effect of each one. PLS accounts for all of the different red blood cell constituents, e.g., various forms of hemoglobin and other cellular bodies, by relating the optical measurements to a single parameter, hematocrit.

Ex. 1030 at 6:42-59.

The actual blood hematocrit is recorded as a Single numerical value, while the optical Spectrum, e.g., a reflection or absorption spectrum, is in the form of an x-y array of points. The x values of the array represent particular optical wavelengths or frequencies, while the y values represent either reflectance or absorption intensities corresponding to these wavelengths or frequencies.

Ex. 1030 at 7:18-25. Soller further discloses: "FIG.2 shows a representative graph plotting the predicted hematocrit as determined by the model as a function of the actual hematocrit generated using the cross-validation procedure." Ex. 1030 at 11:5-8.



Ex. 1030, Figure 2

222. A POSITA would recognize that the two systems are not compatible at the system level, because the measurement objectives and signal-processing mathematical models are fundamentally different. Lisogurski’s oxygen saturation computation depends on “two wavelengths of light and a ratio-of-ratios calculation,” which is meaningful only under a two-channel absorption comparison tied to oxygenation changes. Ex. 1027 at 4:42-56, 24:58-25:5, 45:6-21. Soller, in contrast, is built around accounting for multiple hemoglobin species and cellular components and therefore requires “a larger set of wavelengths” plus “a multivariate calibration technique.” Ex. 1030 at 5:33-63. A POSITA would not view these as interchangeable signal processing options; rather, Soller’s approach replaces the

simplified dual-wavelength HbO₂/Hb inference model with a multi-constituent spectral analysis approach. Ex. 1027 at 45:6-21; Ex. 1030 at 5:33-63.

223. Combining Soller with Lisogurski would not “improve” Lisogurski’s dual-wavelength oximetry; it would require substantial redesign and would undermine Lisogurski’s intended measurement principle. For example, the redesign includes reengineering Lisogurski’s light source array with optic cables, significantly increasing the count of the light sources and detectors, and replacing its two-channel ratio-of-ratios processing with a multi-wavelength spectral calibration model to acquire and analyze a much larger dataset. Ex. 1027 at 45:6-21; Ex. 1030 at 5:33–63, 11:5–8. The resulting system would no longer measure blood oxygen saturation using Lisogurski’s two-channel ratio-of-ratios approach and would therefore undermine the very principle Lisogurski implements. Ex. 1027 at 45:6-21; Ex. 1030 at 5:33–63, 11:5–8. Lisogurski is expressly optimized for blood oxygen estimation by comparing the intensities of “two wavelengths” and using “a ratio-of-ratios calculation,” which assumes the dominant relevant absorbers are oxygenated and deoxygenated hemoglobin. Ex. 1027 at 4:42-56, 17:65-66, 24:58-25:5, 45:6-21. Soller, however, teaches that measuring blood properties using only oxygenated and deoxygenated hemoglobin is the hallmark of “oximetric methods” and requires a different approach through accounting for additional components using a broad band of wavelengths and multivariate calibration. Ex. 1030 at 5:33-

63. A POSITA would therefore understand that adopting Soller’s framework would shift Lisogurski away from its dual-wavelength ratio-of-ratios calculation oximetry architecture and toward a different multi-wavelength spectral modeling paradigm—making the proposed combination fail to deliver the intended outputs of either system—at least because (i) applying Soller’s mathematical model and system would not produce the oxygen-saturation output Lisogurski is designed to generate because Soller is calibrated to estimate hematocrit from a broad, multi-wavelength spectrum reflecting multiple blood constituents, not to compute blood oxygen level from the red/IR pulsatile absorption relationship captured by two channels, and (ii) applying Lisogurski’s ratio-of-ratios calculation would not produce Soller’s predicted hematocrit result because the ratio-of-ratios algorithm assumes only two wavelengths selected for oxy- and deoxyhemoglobin discrimination, whereas Soller’s hematocrit prediction requires multi-wavelength spectral data calibration across multiple constituents. Ex. 1027 at 45:6-21; Ex. 1030 at 5:33-63, 11:5-8.

ii. Soller’s Alleged Arc Arrangement Is Specifically Tied to Soller’s Hematocrit Measurement Configuration, Which Lisogurski Does Not Use, And Petitioner Fails to Show That Soller’s Alleged Arc Arrangement Applies to Lisogurski

224. Petitioner and Dr. Mercier argue that a POSITA would have been motivated to based on Soller to modify Lisogurski to include LEDs and detectors configured in one or more arc to increase “portab[ility]” and “accuracy.” Petition at

61, 25-28; Ex. 1003 at ¶¶ 209-10. Dr. Mercier argues that “[a] POSITA would therefore have understood that modifications to the arrangement and number of LEDs and detectors in Lisogurski’s sensor unit would have been straightforward design modifications within the skill of a POSITA, which would carry a reasonable expectation of success.” Ex. 1003 at ¶ 210; *see also* Petition at 56-61, 25-28. I disagree for at least the following reasons.

225. Petitioner and Dr. Mercier’s assertions of increased “portab[ility],” increased “accuracy,” and “straightforward design modifications” are conclusory and untethered to Soller’s actual disclosure. Ex. 1003 at ¶¶ 209-10; Petition, 56-61, 25-28.

226. The Petition relies on Soller’s Figure 11A embodiment for the alleged arc arrangement of LEDs and detectors. Petition at 59-61. For Petitioner and Dr. Mercier’s assertions of increased “portab[ility]” and increased “accuracy,” Petitioner and Dr. Mercier rely on other, unrelated embodiments in Soller that are different from the Figure 11A embodiment. Petition at 61 (citing Ex. 1030 at 15:50-56, 13:40-49, 15:31-40, 16:33-39), 27 (similar); Ex. 1003 at ¶¶ 209-10 (citing Ex. 1030 at 15:50-56, 13:40-49, 16:33-39, 15:31-40).

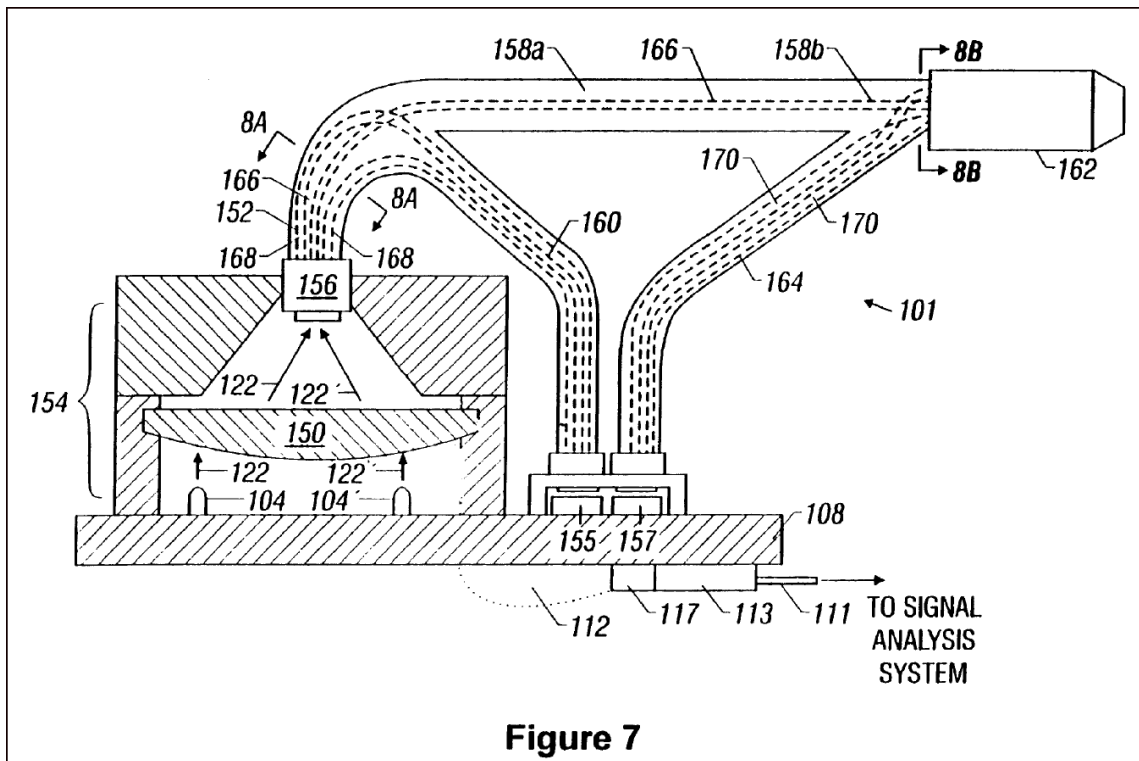
227. For the arc limitation, Dr. Mercier relies on Soller’s Figure 11A embodiment (like the Petition) and also relies on other embodiments and aspects of Soller. Ex. 1003 at ¶¶ 202-12 (citing Ex. 1030 at 13:13-18, 13:35-63, 15:31-40,

15:50-56, 16:6-48, 17:36-60, 18:18-46, FIGS. 11A, 11C, 9). For example, Dr. Mercier relies on embodiments specific to fiber optics for an alleged “ring-like” arrangement and alleged motivation. Ex. 1003 at ¶¶ 202-04 (citing Ex. 1030 at 16:6-48, FIG. 9, 18:18-46), 210 (citing Ex. 1030 at 16:33-39). The Petition also relies on an embodiment specific to fiber optics for alleged motivation. Petition at 61 (citing Ex. 1030 at 16:33-39).

228. Petitioner and Dr. Mercier rely on descriptions of Soller that disclose a fiber-optic or porthold coupling architecture relating to the arrangement of the LEDs in which the LEDs do not illuminate the sample directly. Ex. 1030 at 3:19-22, 12:30-31, FIG. 9, 13:35-63. Soller explains that “a fiber optic cable is attached to each light source” and “[t]he fiber optic cable includes a delivery fiber for delivering radiation [from the light source] to the sample.” Ex. 1030 at 3:19-22. Soller further explains that as shown in Figure 3, “[t]he radiation is delivered via an optical delivery cable 80 to a probe 82 positioned in close proximity to the skin 73.” Ex. 1030 at 12:30-31. Soller also explains that “[t]he mounting plate 108 includes a series of portholes 109, 109’ positioned above each LED so that radiation 122, 122’ can pass through the mounting plate 108 and onto the sample.” Ex. 1030 at 13:35-49.

229. Soller likewise explains that “FIG. 7 shows [] an integrated hematocrit measuring device 101 wherein radiation 122, 122’ from the LEDs 104, 104’ is focus[ed] by a lens 150 into a fiber optic cable 152. A lens housing 154 attached to

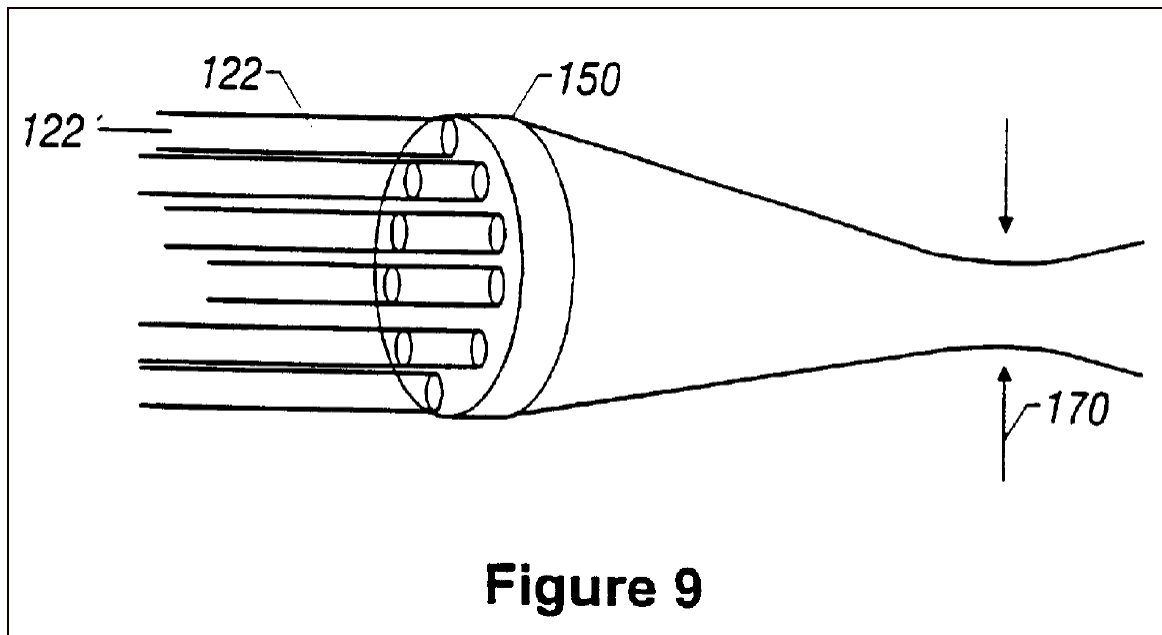
the mounting plate 108 is used to support both the lens 150 and an annular fiber housing 156 disposed radially around the fiber optic cable 152.” Ex. 1030 at 15:57-63, 16:39-48. Thus, the alleged “ring-like” LED arrangement in Soller is expressly disclosed as part of a specific fiber-optic coupling architecture used to deliver radiation to the tissue within a hematocrit analysis system. Ex. 1030 at 15:57-63, 16:39-48.



Ex. 1030, Figure 7

230. Soller confirms that the reason for arranging LEDs in the geometry of Figure 9 is to maximize optical coupling into a fiber optic cable: “[t]he component of the light from each LED that is collimated will be focused by the lens into a small spot at the entrance end of cable [152], thereby maximizing the amount of radiation

coupled into the fiber optic cable.” Ex. 1030 at 16:44-48. Soller emphasizes that the geometry is organized around the fiber optic delivery cable and its mechanical support, including “an annular fiber housing ... disposed radially around the fiber optic cable.” Ex. 1030 at 15:60-63. A POSITA would therefore recognize that Soller’s LED geometry is inseparable from its fiber optic delivery scheme and is not disclosed as a general illumination geometry in a compact wearable sensor. Ex. 1030 at 15:57-63, 16:39-48.



Ex. 1030, Figure 9

231. The alleged “ring-like” arrangement in Soller is a solution to a specific optical coupling problem associated with routing LED radiation into a fiber or porthole. Ex. 1030 at 15:57-63, 16:39-48, 13:35-49. In other words, the LEDs are arranged in Soller so that their light is delivered to a fiber optic delivery cable or

porthole for hematocrit analysis. Ex. 1030 at 16:39-48, 13:35-49. Relatedly, a POSITA would understand that Soller's fiber optic delivery or porthole path inherently defines the illumination "dimension" at the sample by the fiber geometry, not by the LED package itself. Soller teaches that "radiation ... from the LEDs ... is focus[ed] by a lens ... into a fiber optic cable," meaning the fiber optic cable becomes the effective optical output aperture, and the illumination area and angular distribution at the sample are fundamentally constrained by the fiber's geometry and coupling optics. Ex. 1030 at 15:57-63, 16:39-48. Soller states that "the optical delivery and signal fibers have diameters of between about 0.1 and 2 mm, and 10 to 500 microns, respectively." Ex. 1030 at 13:10-12.

232. Soller's disclosure further demonstrates that the fiber optic cable or porthole is not incidental, but is integral to the measurement architecture, including reference measurement paths. Ex. 1030 at 16:8-21, 13:35-49. As discussed in Sections X.A.2.b and X.A.2.c above, the reference detectors perform a different function than the reflectance detector and the reference detectors are absent from Lisogurski. The optical fiber structures are specifically arranged to support the bifurcated optical path associated with the reflectance detector and the reference detectors in Soller. Ex. 1030 at 16:8-12. Soller explains that in FIG. 7, "[t]he fiber optic cable 152 is bifurcated at a first point 158a to deliver a portion of the incident radiation through a first fiber optic cable section 160 to a reference detector 155.

This radiation is then processed to determine the reference spectrum,” confirming that the fiber cable structure participates directly in measurement and calibration functionality. Ex. 1030 at 16:8-12.

233. Soller further explains:

Accordingly, as shown in FIG. 8A, a cross-sectional slice of the fiber optic cable 152 immediately after the fiber housing 156 features a delivery fiber 166 surrounded by radially and symmetrically disposed reference fibers 168. During operation, radiation from the LEDs is focus[ed] by the lens into both the delivery 166 and reference fibers 168. Radiation from the delivery fiber passes through the cable and onto a sample, while radiation coupled into the reference fibers propagates through the first fiber optic cable section 160 and onto the reference detector 155.

Ex. 1030 at 16:12-21. This reinforces that Soller’s system is architected around fiber-based optical bifurcated routing and signal handling for the hematocrit measurement, which in turn motivates the annular/radial LED coupling arrangement. Ex. 1030 at 15:57-63, 16:8-21, 16:39-48, FIG. 7, FIG. 9.

234. Lisogurski, on the other hand, does not disclose or require any fiber-optic delivery cable or porthole coupling architecture from light sources to the sample tissue. Lisogurski instead teaches a compact wearable sensor for a different physiological variable, oxygen saturation, in which LEDs directly illuminate tissue and reflected/transmitted light is detected locally. See, e.g., Ex. 1027 at FIG. 1, 4:6-11, 10:42-11:20. Lisogurski discloses that “[a]n oximeter may include a light sensor that is placed at a site on a patient, typically a fingertip, toe, forehead or earlobe, or

in the case of a neonate, across a foot” and it “may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue.” Ex. 1027 at 4:6-11. Lisogurski further explains that “[s]uitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light.” Ex. 1027 at 4:21-22. A POSITA would understand that Lisogurski’s measurement paradigm relies on direct optical interaction between the LEDs, tissue, and detector at the sensor site—without any need for an intervening fiber optic delivery conduit. Ex. 1027 at 4:6-11, 4:21-22.

235. Lisogurski’s disclosed implementation further confirms that its LEDs are intended to directly illuminate tissue, not to be coupled into a fiber. Ex. 1027 at 4:6-11, 4:21-22, 12:11-16. Lisogurski explains that when the “red and IR light emitters” are driven, “they emit pulses of light at their respective wavelengths into the tissue of a subject.” Ex. 1027 at 12:11-16. Lisogurski further teaches that “detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths,” and that this light is received “after passing through the subject’s tissue.” Ex. 1027 at 11:9-14. This is the opposite of Soller’s fiber-coupling design, where radiation of light sources is “focus[ed] ... into a fiber optic cable” via annular fiber housings, and the fiber output defines the illumination aperture and distribution. Ex. 1030 at 15:57-63, 16:8-21, 16:39-48, 13:35-49; Ex. 1027 at FIG. 1, 4:6-11, 10:42-11:20, 12:11-16.

236. Lisogurski also confirms that the only “cable” it discusses is a communication cable, not an optical delivery fiber. Specifically, Lisogurski states: “Monitor 314 may be communicatively coupled ... via a cable” to a sensor input port or digital communications port. Ex. 1027 at 18:58-62, 18:16-23. Thus, Lisogurski contains no disclosure of delivering light from LEDs through a fiber optic cable or porthole, and therefore none of the optical coupling constraints that motivate Soller’s alleged “ring-like” LED arrangement exist in Lisogurski. Ex. 1027 at 18:58-62, 18:16-23, 13:35-49; Ex. 1030 at 16:39-48.

237. Because fiber delivery or porthole inherently reduces the illumination aperture to the fiber output and imposes a different angular distribution, the illumination “dimension” and coupling physics in Soller are fundamentally different from—and incompatible with—Lisogurski’s direct-illumination wearable architecture. Soller requires “[t]he component of the light from each LED that is collimated will be focused by the lens into a small spot at the entrance end of [the fiber optic] cable” and mechanical structures “disposed radially around the fiber optic cable,” indicating that the system is designed around fiber input and output constraints. Ex. 1030 at 15:57-63, 16:8-21, 16:39-48, FIG. 7, FIG. 9. Lisogurski, in contrast, is designed around LEDs that directly “emit pulses of light ... into the tissue” and a local detector that receives that tissue-modulated light, with no suggestion that the light is routed and bifurcated through an optical delivery path.

Ex. 1027 at FIG. 1, 4:6-11, 10:42-11:20, 12:11-16. A POSITA would recognize that these different illumination geometries are not interchangeable because they define different optical footprints, coupling efficiencies, and spatial distributions at the tissue. Ex. 1027 at 4:6-11, 4:21-22, 12:11-16; Ex. 1030 at 15:57-63, 16:39-48, 13:35-49.

238. Importing Soller's fiber-driven or porthole-driven LED geometry into Lisogurski would be both unnecessary and incompatible with Lisogurski's compact direct-illumination oximetry structure. Soller's configuration is expressly tied to focusing LED radiation "by the lens into both the delivery 166 and reference fibers 168" and to structures "disposed radially around the fiber optic cable." Ex. 1030 at 15:57-63, 16:8-21, 16:39-48, 13:35-49, FIG. 9. Soller expressly discloses the probe dimensions and fiber spacing, explaining that "[p]robe fibers 740 from fiber splitter 735 are combined into a single fiber bundle 750 terminating at a probe tip 790. Light from fiber bundle 750 illuminates sample 705. ...The spacing between the center illuminating fiber bundle 750 and the outer fiber ring 781 is preferably 2-4 mm when the probe tip 790 has a diameter of 5 mm." Ex. 1030 at 18:43-46, FIG. 7, FIG. 9.

239. Soller emphasizes that hematocrit measurement should sample tissue containing a significant amount of blood with specific optic fiber geometry:

spacing of the individual fibers used to conduct these measurements was approximately 40 microns. Referring to FIG. 14B, a separation of 1–5 mm, of the receiving fiber 1030 from the illuminating fibers 1020, arranged in a

radially symmetric array about receiving fiber 1030, facilitates obtaining adequate depth penetration into the tissue being sampled by the light received by the receiving fiber 1030. If the spacing of the illumination fibers 1020 from the receiving fiber 1030 is too small then the majority of the reflected light signal received by receiving fiber 1030 will originate at the air/tissue interface which does not contain a significant amount of blood. Also, the geometry of the fiber optic probe is likely to be a limiting factor in the noise level in the spectral data obtained.

Ex. 1030 at 21:20-34.

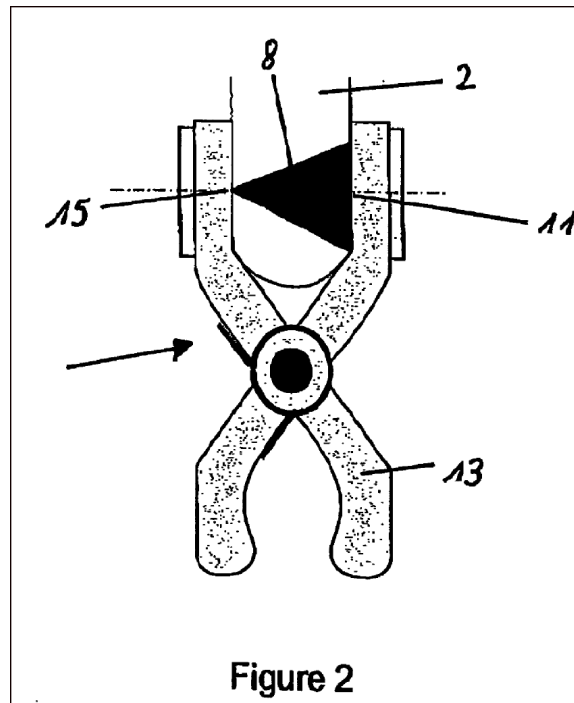
240. Lisogurski, on the other hand, teaches a local wearable sensor in which LEDs “emit pulses of light ... into the tissue of a subject” and reflected/transmitted light is detected locally at the sensor. Ex. 1027 at FIG. 1, 4:6-11, 10:42-11:20, 12:11-16. Pulse oximetry does not depend on ensuring the sampled region contains a “significant amount of blood” in the same sense as hematocrit measurement, because it mathematically isolates the pulsatile arterial contribution and corrects for tissue/venous background absorption:

Most of the absorbance is caused by the tissue and venous blood (which is relatively constant and comprises the fixed component of the absorbance) with a small proportion attributable to the pulsatile component caused by inflow of arterial blood. The pulse oximeter calculates the ratio of the pulsatile component with the non-pulsatile component. This ratio is calculated separately for each of the two wavelengths (by having the light-emitting diodes alternately turning off and on), and it is the ratio of these two ratios which is empirically related to arterial oxygen saturation. In this way, the oximeter is able to correct for the underlying light absorption of the tissue and venous blood and effectively ‘focus’ on the arterial blood and thereby display arterial oxygen saturation. This reading is relatively independent of the intensity of the light, the thickness of the tissue and the degree of skin pigmentation.

Ex. 2052, at 5.

241. Because Lisogurski lacks by design—and does not require—any fiber optic delivery or porthole delivery and reference cable/detector constraint to direct a region of “significant amount of blood,” a POSITA would have had no reason to adopt Soller’s fiber-coupling or porthole geometry and would understand that doing so would introduce an architectural feature absent from and unneeded by Lisogurski’s oxygen-measurement structure. Ex. 1027 at 4:6-11, 4:21-22, 12:11-16; Ex. 1030 at 15:57-63, 16:39-48. Petitioner and Dr. Mercier do not address how a POSITA could incorporate Soller’s fiber-optic or porthole delivery configuration into Lisogurski’s system—either by implementing Soller’s approach without the requisite optic cables/portholes or by explaining how adding those cables/portholes (and their associated components) would not increase the size and complexity of Lisogurski’s device in a manner inconsistent with its portable design.

242. Petitioner and Dr. Mercier also fail to explain why a POSITA would have chosen an arc arrangement from amongst the wide array of non-arc arrangement options (e.g., a single element or linear designs), let alone the alleged arc arrangement in Soller’s FIG. 11A. Petition at 59-61; Ex. 1003 at ¶¶ 202-12. For example, Carlson discloses a single-detector configuration in which “[t]he sensor or ear clip 13 ... includes a light source 15 which emits a light beam 8 to a light receiver 11,” as shown in FIG. 2. Ex. 1028 at ¶ [0049], FIG. 2.



Ex. 1028 at FIG. 2

243. Carlson also discloses “optical radiation 8 emitted from the two LEDs 15” in FIG. 4 as a linear configuration of the LEDs. Ex. 1028 at ¶ [0054], FIG. 4.

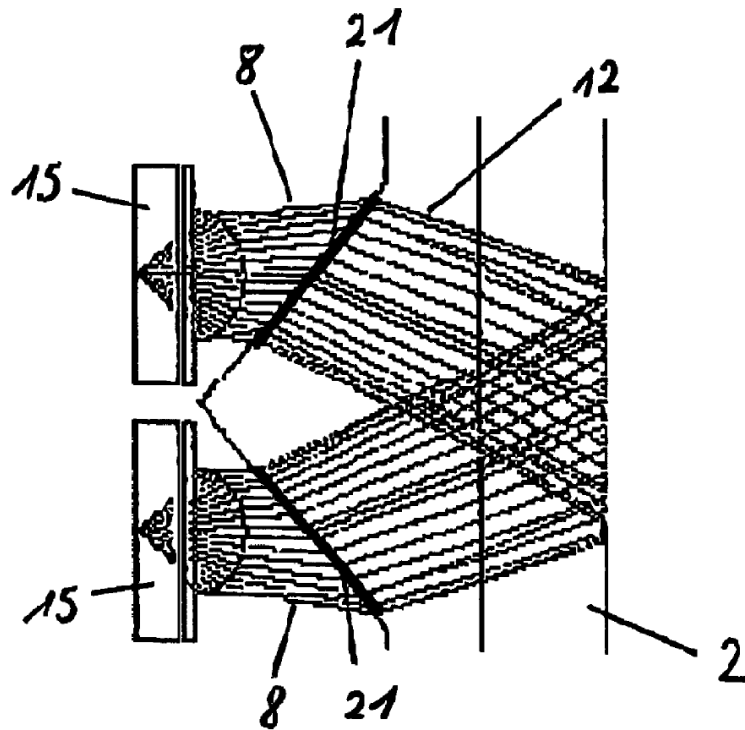


Figure 4

Ex. 1028 at FIG. 4

244. Indeed, Dr. Mercier acknowledges that “Lisogurski does not ... teach arranging the LEDs and detectors in arcs.” Ex. 1003 at ¶ 210.

245. In addition, Petitioner and Dr. Mercier argue at a high level that all three references involve optical measurement systems and that Lisogurski’s goal of improving SNR would have motivated a POSITA to look to Soller for accuracy improvements, including “[i]mplementing Soller’s ... arrangement and number of LEDs and detectors into Lisogurski.” Petition at 25-28; Ex. 1003 at ¶¶ 98-103. But that reasoning, at most, supports a general desire to improve performance—not a reasoned basis to adopt Soller’s *particular* arc/ring-like configuration (and multi-

LED/multi-detector structure) in Lisogurski's specific wearable oximetry sensor. Petition at 25-28, 57-61; Ex. 1003 at ¶¶ 98-103. Petitioner and Dr. Mercier do not identify any deficiency in Lisogurski that would be solved specifically by adopting Soller's arc geometry (as opposed to any number of LEDs/detector layouts), and they never explain why Soller's solution—developed for multi-wavelength hematocrit spectral analysis—would be expected to improve a dual-wavelength ratio-of-ratios oximeter. Petition at 25-28, 59-61; Ex. 1003 at ¶¶ 98-103, 202-12. In other words, Petitioner's and Dr. Mercier's motivation is too generalized and amounts to improper hindsight. Petitioner and Dr. Mercier assert a POSITA would use Soller's ring in Lisogurski, without explaining why that specific selection would have been made or why it would yield predictable results in Lisogurski's system. Petition at 59-61; Ex. 1003 at ¶¶ 202-12.

246. Lastly, Petitioner and Dr. Mercier never explain the implementation details necessary to support a reasonable expectation of success. Petition, 28, 59-61; Ex. 1003 at ¶¶ 103, 202-12. The Petition and Dr. Mercier assert that applying Soller's modifications to the "arrangement and number" of LEDs and detectors in Lisogurski would have been "routine" and "not require significant time or cost-intensive changes." Petition at 28, 61; Ex. 1003 at ¶¶ 103, 210. But Petitioner and Dr. Mercier do not address what redesign would be required to (i) add Soller's many-wavelength LED array to Lisogurski's two-wavelength oximetry sensor, (ii) incorporate Soller's

multiple detector scheme (including reference detectors), or (iii) reconcile Soller's correction and calibration framework with Lisogurski's time-varying, two-channel oximetry processing. Petition at 25-28, 59-61; Ex. 1003 at ¶¶ 98-103, 202-12. Without those details, Petitioner has not shown that the modification is truly routine or that the outcome would be predictable.

iii. The Alleged Detectors in Soller Serve a Reference-Calibration Function Absent from Lisogurski

247. As noted above, Petitioner and Dr. Mercier rely on Soller—not Lisogurski—to supply the “arc” arrangement required by the arc limitation of claim 2. Dr. Mercier and Petitioner mainly point to the “interior detector” or “reference detector” 610 arrangements in FIGS. 11A and 11B to show the alleged detector arc. Ex. 1003 at ¶¶ 202-212; Petition at 56-61.

248. However, Soller expressly explains that these reference detectors are not used to “receive at least a portion of the lens output light reflected from the tissue” as required by the independent claims (e.g., claim 1) of the '455 Patent. Ex. 1001 at 86:54-61. Instead, “the interior detector 350 monitors the optical output emitted from the LEDs” and serves a reference calibration function: “[r]adiation detected by the interior detector is used to determine a reference spectrum which allows intensity variations from the various LEDs to be accounted for.” Ex. 1030 at 17:1-5.

249. Similarly, Soller states that the reference detectors 610 are used “to measure and correct for variations in the LED intensity due to temperature, aging, or electrical power source drifts.” Ex. 1030 at 17:45-48.

250. Lisogurski contains no reference detector and no disclosure of correcting LED intensity variations using a separate, spatially arranged reference detector. Ex. 1027 at 10:48-11:27. Instead, Lisogurski uses the same detector 140 to detect light “after [the light] passing through the subject’s tissue.” Ex. 1027, 11:13-14. Lisogurski further explains that “[t]he light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140.” Ex. 1027 at 11:16-20.

251. Dr. Mercier and Petitioner fail to explain how or why a POSITA would graft Soller’s reference-detector architecture—designed for spectral calibration of hematocrit measurement—onto Lisogurski’s oximetry system, which neither needs nor contemplates such detectors.

252. As discussed above, Lisogurski and Soller address different physiological parameters, rely on incompatible optical architectures and signal models, and pursue distinct design goals. Soller expressly distinguishes from oximetry, and its LED arrangement geometry is tied to fiber-optic coupling and spectral calibration, absent from Lisogurski.

253. Therefore, the combination of Lisogurski and Soller does not render obvious this arc limitation at least because a POSITA would not have been motivated to apply Soller's alleged arc arrangement in Lisogurski.

f) Petitioner and Dr. Mercier Similarly Do Not Show that a POSITA Would Have Been Motivated to Implement Soller's Alleged Arc Arrangement in Carlson to Meet the Arc Limitation

254. Petitioner and Dr. Mercier argue that “[a] POSITA would have considered the optical measurement systems taught by Lisogurski, Carlson, and Soller together; they are analogous systems with common applications and utility.” Petition at 25; Ex. 1003 at ¶¶ 98, 103. Petitioner and Dr. Mercier further state that “all three describe techniques for improving the performance of wearable, optical devices that can be used to remotely monitor physiological parameters, including blood oxygen saturation.” Petition at 25-26; Ex. 1003 at ¶¶ 98, 103.

255. For similar reasons with respect to the combination of Lisogurski and Soller as discussed above, Petitioner and Dr. Mercier likewise fail to show that a POSITA would have been motivated to combine Soller's alleged arc arrangement with Carlson's system. Petition at 25-28, 56-61; Ex. 1003 at ¶¶ 98-103, 202-12.

256. Carlson is directed to “optical pulsoximetry used for non-invasive measurement of pulsation and oxygen saturation in arterial human or animal blood.” Ex. 1028 at ¶¶ [0002]-[0003]. Similar to Lisogurski, Carlson relies on conventional

dual-wavelength pulse oximetry principles—measuring absorption differences between oxygenated and deoxygenated hemoglobin. Ex. 1028 ¶ [0003]. Soller, by contrast, is directed to hematocrit measurement using multi-wavelength spectral acquisition and mathematical modeling of red blood cell constituents. Ex. 1030 at Abstract; 1:49-62. A POSITA would have recognized that Soller’s spectral modeling hematocrit measurement framework is fundamentally different from—and incompatible with—Carlson’s dual-wavelength, time-varying oximetry architecture, which mirrors the system implemented in Lisogurski. Ex. 1030 at Abstract; 1:49–62.

257. Moreover, aspects of the physical arrangement of LEDs in Soller are driven by a design constraint of the fiber-optic delivery cable that is entirely absent from Carlson. Soller discloses fiber-optic delivery cables attached to light sources and explains that its LED arrangement is used to maximize optical coupling into a fiber-optic cable by focusing collimated light into a small spot at the cable entrance. Ex. 1030 at 3:19-22; 12:30-31; 16:44-48. Carlson does not disclose or require any fiber-optic delivery cable, annular fiber housing, or lens-to-fiber coupling architecture. Instead, Carlson teaches compact pulse oximeter sensors in which LEDs directly illuminate tissue and detector placement is optimized to reduce ambient-light interference. *See, e.g.*, Ex. 1028 at ¶¶ [0048]-[0052], [0073], Figs. 1, 2, 10a, 10b. Because Carlson lacks the very fiber-optic coupling problem that

motivates Soller's alleged arc arrangement, a POSITA would have had no reason to import Soller's geometry into Carlson's sensor.

258. Finally, Petitioner and Dr. Mercier attempt to rely on Soller's "interior" or "reference" detectors to supply the alleged detector arc (Ex. 1003 at ¶¶ 202-212; Petition at 56-61), but those detectors serve a calibration function that Carlson neither discloses nor needs. Soller explains that its reference detectors monitor LED output to generate a reference spectrum and correct for LED intensity variations due to temperature, aging, or power drift. Ex. 1030 at 17:1-5; 17:45-48. Carlson, by contrast, "receiving and detecting the emitted and shaped light with at least one light receiving element for determining the light transmitted through the tissue portion of the person or the animal." Ex. 1028 at ¶ [0025]. Dr. Mercier offers no explanation as to why a POSITA would graft Soller's reference-detector architecture—designed for spectrally calibrated hematocrit analysis—onto Carlson's pulsoximetry system. His assertion that such modifications would have been "routine modification" having "a reasonable expectation of success" (Ex. 1003 at ¶ 103) is conclusory and relies on hindsight rather than any articulated technical rationale grounded in the prior art.

259. Therefore, the combination of Lisogurski, Carlson, and Soller does not render obvious this arc limitation at least because a POSITA would not have been motivated to apply Soller's alleged arc arrangement in Lisogurski and Carlson.

3. Dependent Claims 3-4

260. I disagree with Petitioner and Dr. Mercier's assertion that claims 3-4 are obvious over Lisogurski, Carlson, and Soller.

261. Claim 3 depends from claim 2, which depends from independent claim 1, and claim 4 depends from claim 3. Petitioner and Dr. Mercier's analysis of claims 3-4 focuses on the additional limitations of claims 3-4 and does not address any of the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claims 1 and 2. Petition at 61-64; Ex. 1003 at ¶¶ 213-26.

262. Therefore, Lisogurski, Carlson, and Soller do not render obvious claims 3-4 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 2.

4. Independent Claim 8

263. I disagree with Petitioner and Dr. Mercier's assertion that claim 8 is obvious over Lisogurski, Carlson, and Soller.

264. Claim 8 includes limitation 8[a] that recites, in part, "a wearable device ... including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes." Ex. 1001 at 87:62-65; Petition at 86. In particular, a portion of limitation 8[a] recites "a light source *comprising* a driver," which is also recited by limitation 1[a]. Ex. 1001 at 87:63 (emphasis added), 86:46-47; Petition at 86, 84.

265. For limitation 8[a], Petitioner and Dr. Mercier rely on their analysis of limitation 1[a], and they do not separately analyze limitation 8[a] regarding the claim limitation of “a light source comprising a driver.” Petition at 29-33; Ex. 1003 at ¶¶ 228, 121-31. For limitation 8[a], Petitioner and Dr. Mercier do not address any of the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to limitation 1[a]. Petition at 29-33; Ex. 1003 at ¶¶ 228, 121-31.

266. Therefore, Lisogurski, Carlson, and Soller do not teach or render obvious the portion of limitation 8[a] that recites “a light source comprising a driver” for at least the same reasons explained in Section X.A.1 above with respect to limitation 1[a].

5. Dependent Claim 9

267. I disagree with Petitioner and Dr. Mercier’s assertion that claim 9 is obvious over Lisogurski, Carlson, and Soller.

268. Claim 9 depends from independent claim 8. I understand that for claim 9, Petitioner and Dr. Mercier rely on their analysis of claim 2, and their analysis of claim 2 does not address any of the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 8. Petition at 56-61; Ex. 1003 at ¶¶ 239, 202-12.

269. Therefore, Lisogurski, Carlson, and Soller do not render obvious claim 9 for at least the same reasons explained in Section X.A.4 above with respect to independent claim 8.

270. Additionally, I understand that claim 9 recites “wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs,” which is also recited by claim 2. Ex. 1001 at 88:40-42, 87:29-31; Petition at 87, 85.

271. I understand that for claim 9, Petitioner and Dr. Mercier rely on their analysis of claim 2, and they do not separately analyze claim 9. Petition at 56-61; Ex. 1003 at ¶ 239. Petitioner and Dr. Mercier’s analysis of claim 9 does not address any of the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 2. Petition at 56-61; Ex. 1003 at ¶ 239.

272. Therefore, Lisogurski, Carlson, and Soller do not render obvious claim 9 for at least the same reasons explained in Section X.A.2 above with respect to claim 2.

6. Dependent Claim 10

273. I disagree with Petitioner and Dr. Mercier’s assertion that claim 10 is obvious over Lisogurski, Carlson, and Soller.

274. Claim 10 depends from claim 9, which depends from independent claim 8. I understand that for the additional limitations of claim 10, Petitioner and Dr.

Mercier rely on their analysis of limitation 1[k], and their analysis of limitation 1[k] does not address any of the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claims 8 and 9. Petition at 54-56; Ex. 1003 at ¶¶ 240, 195-201.

275. Therefore, Lisogurski, Carlson, and Soller do not render obvious claim 10 for at least the same reasons explained in Section X.A.4 above with respect to independent claim 8 and in Section X.A.5 above with respect to claim 9.

7. Dependent Claim 11

276. I disagree with Petitioner and Dr. Mercier's assertion that claim 11 is obvious over Lisogurski, Carlson, and Soller.

277. Claim 11 depends from independent claim 8. I understand that for claim 11, Petitioner and Dr. Mercier rely on their analysis of claims 3-4, and their analysis of claims 3-4 does not address any of the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 8. Petition at 65, 61-64; Ex. 1003 at ¶¶ 241, 213-26.

278. Therefore, Lisogurski, Carlson, and Soller do not render obvious claim 11 for at least the same reasons explained in Section X.A.4 above with respect to independent claim 8.

8. Independent Claim 15

279. I disagree with Petitioner and Dr. Mercier's assertion that claim 15 is obvious over Lisogurski, Carlson, and Soller.

280. Claim 15 includes limitation 15[a] that recites, in part, "a wearable device ... including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes." Ex. 1001 at 89:8-11; Petition at 88. In particular, a portion of limitation 15[a] recites "a light source *comprising* a driver," which is also recited by limitation 1[a] (and limitation 8[a]). Ex. 1001 at 89:9-10 (emphasis added), 86:46-47, 87:63; Petition at 88, 84, 86.

281. For limitation 15[a], Petitioner and Dr. Mercier rely on their analysis of limitation 1[a], and they do not separately analyze limitation 15[a] regarding the claim limitation of "a light source comprising a driver." Petition at 29-33; Ex. 1003 at ¶¶ 243, 121-31. For limitation 15[a], Petitioner and Dr. Mercier do not address any of the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to limitation 1[a]. Petition at 29-33; Ex. 1003 at ¶¶ 243, 121-31.

282. Therefore, Lisogurski, Carlson, and Soller do not teach or render obvious the portion of limitation 15[a] that recites "a light source comprising a driver" for at least the same reasons explained in Section X.A.1 above with respect to limitation 1[a].

283. Additionally, I understand that claim 15 includes limitation 15[k] that recites “wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs,” which is also recited by claim 2. Ex. 1001 at 90:6-9, 87:29-31; Petition at 89, 85.

284. I understand that for limitation 15[k], Petitioner and Dr. Mercier rely on their analysis of claim 2, and they do not separately analyze limitation 15[k]. Petition at 56-61; Ex. 1003 at ¶ 253. Petitioner and Dr. Mercier’s analysis of limitation 15[k] does not address any of the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 2. Petition at 56-61; Ex. 1003 at ¶ 253.

285. Therefore, Lisogurski, Carlson, and Soller do not render obvious limitation 15[k] for at least the same reasons explained in Section X.A.2 above with respect to claim 2.

9. Dependent Claim 16

286. I disagree with Petitioner and Dr. Mercier’s assertion that claim 16 is obvious over Lisogurski, Carlson, and Soller.

287. Claim 16 depends from independent claim 15. I understand that for claim 16, Petitioner and Dr. Mercier rely on their analysis of limitation 1[k] (and claim 10) and claim 4, and their analysis of limitation 1[k] (and claim 10) and claim 4 does not address any of the aforementioned deficiencies regarding Lisogurski in

relation to claim 15. Petition at 65, 54-56, 63-64; Ex. 1003 at ¶¶ 255, 195-201, 220-26.

288. Therefore, Lisogurski, Carlson, and Soller do not render obvious claim 16 for at least the same reasons explained in Section X.A.8 above with respect to independent claim 15.

B. Ground 2: Obviousness Based on Lisogurski, Carlson, Soller, and Tran (Claims 5, 12)

289. I understand that Petitioner and Dr. Mercier argue for Ground 2 that claims 5 and 12 of the '455 Patent are obvious over Lisogurski, Carlson, Soller, and Tran. Petition at 11, 65-71; Ex. 1003 at ¶¶ 79, 256-66. I disagree for at least the reasons provided below.

1. Dependent Claim 5

290. I disagree with Petitioner and Dr. Mercier's assertion that claim 5 is obvious over Lisogurski, Carlson, Soller, and Tran.

291. Claim 5 depends from claim 4, which depends from claim 3, which depends from claim 2, which depends from independent claim 1. Petitioner and Dr. Mercier's analysis of claim 5 focuses on the additional limitations of claim 5 and does not address any of the deficiencies I discuss above in relation to claims 1 and 2. Petition at 68-71; Ex. 1003 at ¶¶ 257-64. Petitioner and Dr. Mercier's analysis of claim 5 does not rely on Tran to cure the aforementioned deficiencies regarding

Lisogurski, Carlson, and Soller in relation to claims 1 and 2. Petition at 68-71; Ex. 1003 at ¶¶ 257-64.

292. Therefore, Lisogurski, Carlson, Soller, 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 and in Section X.A.2 above with respect to claim 2.

2. Dependent Claim 12

293. I disagree with Petitioner and Dr. Mercier's assertion that claim 12 is obvious over Lisogurski, Carlson, Soller, and Tran.

294. Claim 12 depends from claim 11, which depends from independent claim 8. I understand that for claim 12, Petitioner and Dr. Mercier rely on their analysis of claim 5, which does not address any of the deficiencies I discuss above in relation to claim 8. Petition at 68-71; Ex. 1003 at ¶¶ 265-66, 257-64. I further understand that Petitioner and Dr. Mercier's analysis of claim 12, including their analysis of claim 5, does not rely on Tran to cure the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 8. Petition at 68-71; Ex. 1003 at ¶¶ 265-66, 257-64.

295. Therefore, Lisogurski, Carlson, Soller, and Tran do not render obvious claim 12 for at least the same reasons explained in Section X.A.4 above with respect to independent claim 8.

C. Ground 3: Obviousness Based on Lisogurski, Carlson, Soller, and Valencell-093 (Claim 17)

296. I understand that Petitioner and Dr. Mercier argue for Ground 3 that claim 17 of the '455 Patent is obvious over Lisogurski, Carlson, Soller, and Valencell-093. Petition at 11, 71-76; Ex. 1003 at ¶¶ 79, 267-73. I disagree for at least the reasons provided below.

1. Dependent Claim 17

297. I disagree with Petitioner and Dr. Mercier's assertion that claim 17 is obvious over Lisogurski, Carlson, Soller, and Valencell-093.

298. Claim 17 depends from claim 16, which depends from independent claim 15. Petitioner and Dr. Mercier's analysis of claim 17 focuses on the additional limitations of claim 17 and does not address any of the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 15. Petition at 73-76; Ex. 1003 at ¶¶ 267-73. Petitioner and Dr. Mercier's analysis of claim 17 does not rely on Valencell-093 to cure the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 15. Petition at 73-76; Ex. 1003 at ¶¶ 267-73.

299. Therefore, Lisogurski, Carlson, Soller, and Valencell-093 do not render obvious claim 17 for at least the same reasons explained in Section X.A.8 above with respect to independent claim 15.

D. Ground 4: Obviousness Based on Lisogurski, Carlson, Soller, Tran, and Valencell-093 (Claims 6-7, 13-14, 18-20)

300. I understand that Petitioner and Dr. Mercier argue for Ground 4 that claims 6-7, 13-14, and 18-20 of the '455 Patent are obvious over Lisogurski, Carlson, Soller, Tran, and Valencell-093. Petition at 11, 76-82; Ex. 1003 at ¶¶ 79, 274-96. I disagree for at least the reasons provided below.

1. Dependent Claim 6

301. I disagree with Petitioner and Dr. Mercier's assertion that claim 7 is obvious over Lisogurski, Carlson, Soller, Tran, and Valencell-093.

302. Claim 6 depends from claim 5, which depends from claim 4, which depends from claim 3, which depends from independent claim 1. I understand that for claim 6, Petitioner and Dr. Mercier rely on their analysis of claims 5 and 17 (including claims 1-4 from which claim 5 depends), and Petitioner also relies on its analysis of claim 16. Petition at 77; Ex. 1003 at ¶ 275. I also understand that their analysis of those claims does not address any of the deficiencies regarding Lisogurski, Carlson, and Soller in relation to claims 1 and 2, which I discuss above. Petition at 77, 68-71, 73-76, 65; Ex. 1003 at ¶¶ 275, 116-201, 257-64, 267-73. I further understand that Petitioner and Dr. Mercier's analysis of claim 6, including their analysis of other claims that they rely upon for claim 6, does not rely on Tran or Valencell-093 to cure the aforementioned deficiencies regarding Lisogurski,

Carlson, and Soller in relation to claims 1 and 2. Petition at 77, 68-71, 73-76, 65; Ex. 1003 at ¶¶ 275, 116-201, 257-64, 267-73.

303. Therefore, Lisogurski, Carlson, Soller, Tran, and Valencell-093 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 2.

2. Dependent Claim 7

304. I disagree with Petitioner and Dr. Mercier's assertion that claim 7 is obvious over Lisogurski, Carlson, Soller, Tran, and Valencell-093.

305. Claim 7 depends from claim 6, which depends from claim 5, which depends from claim 4, which depends from claim 3, which depends from claim 2, which depends from independent claim 1. Petitioner and Dr. Mercier's analysis of claim 7 focuses on the additional limitations of claim 7 and does not address the deficiencies I identify above in relation to claims 1 and 2. Petition at 79-82; Ex. 1003 at ¶¶ 276-84. Petitioner and Dr. Mercier's analysis of claim 7 does not rely on Tran or Valencell-093 to cure the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claims 1 and 2. Petition at 79-82; Ex. 1003 at ¶¶ 276-84.

306. Therefore, Lisogurski, Carlson, Soller, Tran, and Valencell-093 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 2.

3. Dependent Claim 13

307. I disagree with Petitioner and Dr. Mercier's assertion that claim 13 is obvious over Lisogurski, Carlson, Soller, Tran, and Valencell-093.

308. Claim 13 depends from claim 12, which depends from claim 11, which depends from independent claim 8. I understand that for claim 13, Petitioner and Dr. Mercier rely on their analysis of claim 6 that relies in turn on their analysis of other claims, and their analysis of those claims does not address any of the deficiencies I discuss above in relation to claim 8. Petition at 77, 68-71, 73-76, 65; Ex. 1003 at ¶¶ 285, 275, 116-201, 257-64, 267-73. I further understand that Petitioner and Dr. Mercier's analysis of claim 13, including their analysis of other claims that they rely upon for claim 13, does not rely on Tran or Valencell-093 to cure the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 8. Petition at 77, 68-71, 73-76, 65; Ex. 1003 at ¶¶ 285, 275, 116-201, 257-64, 267-73.

309. Therefore, Lisogurski, Carlson, Soller, Tran, and Valencell-093 do not render obvious claim 13 for at least the same reasons explained in Section X.A.4 above with respect to independent claim 8.

4. Dependent Claim 14

310. I disagree with Petitioner and Dr. Mercier's assertion that claim 14 is obvious over Lisogurski, Carlson, Soller, Tran, and Valencell-093.

311. Claim 14 depends from claim 13, which depends from claim 12, which depends from claim 11, which depends from independent claim 8. I understand that for claim 14, Petitioner and Dr. Mercier rely on their analysis of claim 7 for the additional limitations of claim 14, which does not address any of the deficiencies I discuss above in relation to claim 8. Petition at 79-82; Ex. 1003 at ¶¶ 286, 276-84. I further understand that Petitioner and Dr. Mercier's analysis of claim 14, including their analysis of claim 7, does not rely on Tran or Valencell-093 to cure the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 8. Petition at 79-82; Ex. 1003 at ¶¶ 286, 276-84.

312. Therefore, Lisogurski, Carlson, Soller, Tran, and Valencell-093 do not render obvious claim 14 for at least the same reasons explained in Section X.A.4 above with respect to independent claim 8.

5. Dependent Claims 18-20

313. I disagree with Petitioner and Dr. Mercier's assertion that claims 18-20 are obvious over Lisogurski, Carlson, Soller, Tran, and Valencell-093.

314. Claims 18-20 each depend from independent claim 15 via claims 16 and 17. I understand that for claims 18 and 20, Petitioner and Dr. Mercier rely on

their analysis of claims 5 and 7, respectively, and their analysis of claims 5 and 7 does not address any of the deficiencies I discuss above in relation to claim 15. Petition at 77-78 (citing “§VII.C.2” regarding claim 5), 68-71 (claim 5), 79-82; Ex. 1003 at ¶¶ 287-90, 257-64, 296, 276-84. Also, Petitioner and Dr. Mercier’s analysis of claim 19 focuses on the additional limitations of claim 19 and does not address any of the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 15. Petition at 78-79; Ex. 1003 at ¶¶ 291-95. Petitioner and Dr. Mercier’s analysis of claims 18-20, including their analysis of claims 5 and 7 that they rely upon for claims 18 and 20, does not rely on Tran or Valencell-093 to cure the aforementioned deficiencies regarding Lisogurski, Carlson, and Soller in relation to claim 15. Petition at 77-78, 68-71, 78-82; Ex. 1003 at ¶¶ 287-90, 257-64, 291-96, 276-84.

315. Therefore, Lisogurski, Carlson, Soller, Tran, and Valencell-093 do not render obvious claims 18-20 for at least the same reasons explained in Section X.A.8 above with respect to independent claim 15.

XI. CONCLUSION

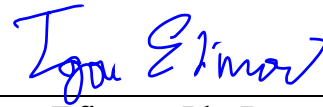
316. In my opinion, the challenged claims of the ’455 Patent would not have been obvious to a POSITA as of the priority date of the ’455 Patent in view of the asserted references that Petitioner and Dr. Mercier rely upon in Grounds 1-4.

Accordingly, it is my opinion that all challenged claims of the '455 Patent are patentable over the asserted references.

317. 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: January 5, 2026



Igor Efimov, Ph. D.