

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

**CURRENT LIGHTING SOLUTIONS, LLC d/b/a GE CURRENT,
PETITIONER,**

v.

**JIAXING SUPER LIGHTING ELEC. APPLIANCE CO., LTD.,
PATENT OWNER.**

***INTER PARTES* REVIEW NO. IPR2023-00984
PATENT NO. 9,841,174**

DECLARATION OF MICHAEL LEBBY, Ph.D.

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LIST OF REFERENCES CONSIDERED

Exhibit	Shorthand	Description
EX1001	'174 Patent	U.S. Patent No. 9,841,174
EX1003	'174 FH	Excerpts from File History of the '174 Patent
EX1004	Sadwick566	PCT App. Pub. No. WO2015/066566
EX1005	Ivey813	U.S. Patent No. 8,596,813
EX1006	Ivey345	U.S. Patent App. Pub. No. 2014/0015345
EX1007	UL1993	<i>UL 1993 Standard for Safety Self-Ballasted Lamps and Lamp Adapters</i> , Underwriters Laboratories Inc., 2012
EX1008	Sadwick	U.S. Patent App. Pub. No. 2017/0311396
EX1009	Powell	U.S. Patent No. 9,438,165
EX1010	Digi-Key	Wayback Machine capture of <i>Product Index > Discrete Semiconductor Products > FETs – Arrays</i> , Digi-Key (Apr. 10, 2014, 11:03 AM), http://www.digikey.com/product-search/en/discrete-semiconductor-products/fets-arrays/1377094 [https://web.archive.org/web/20140410110347/http://www.digikey.com/product-search/en/discrete-semiconductor-products/fets-arrays/1377094]
EX1011	Fairchild	Wayback Machine capture of <i>FDG6303N Dual N-Channel, Digital FET</i> , Fairchild Semiconductor (Mar. 8, 2014, 4:25 AM), http://www.fairchildsemi.com/ds/FD/FDG6303N.pdf [https://web.archive.org/web/20140308042522/http://www.fairchildsemi.com/ds/FD/FDG6303N.pdf]
EX1012	Premier	Wayback Machine capture of <i>Should You Replace Your T8 Fluorescent Lamps with T8 LED Tubes? (updated)</i> , Premier Lighting (June 27, 2014, 9:59 PM), http://www.premierltg.com/should-you-replace-your-t8-fluorescent-lamps-with-t8-led-tubes-2/ [https://web.archive.org/web/20140627215905/http://www.premierltg.com/should-you-replace-your-t8-fluorescent-lamps-with-t8-led-tubes-2/]
EX1013	Hsia661	U.S. Patent App. Pub. No. 2015/0181661

Exhibit	Shorthand	Description
EX1014	Pyeon	U.S. Patent No. 9,240,227
EX1015	Dedic	U.S. Patent App. Pub. No. 2013/0099948
EX1016	Mandal	M.K. Mandal & B.C. Sarkar, <i>Ring oscillators: Characteristics and applications</i> , 48 Indian J. of Pure & Applied Physics 136 (2010)
EX1017	Sadwick454	U.S. Patent No. 8,502,454
EX1018	Parks	Wayback Machine capture of Michael Parks, <i>Don't Burn Out! Calculating LED Current Limiting Resistor</i> , Mouser Electronics (Oct. 10, 2014, 6:43 AM), http://www.mouser.com/blog/dont-burn-out-calculating-led-current-limiting-resistor [https://web.archive.org/web/20141010064339/http://www.mouser.com/blog/dont-burn-out-calculating-led-current-limiting-resistor]
EX1019	Etkina	Eugenia Etkina & Gorazd Planinšič, <i>Light-Emitting Diodes: Exploration of Underlying Physics</i> , 52 The Physics Teacher 212 (2014)
EX1020	Briggs	U.S. Patent No. 8,564,214
EX1021	Guang	U.S. Patent App. Pub. No. 2017/0303353
EX1022	Physics-Classroom	Wayback Machine capture of <i>Two Types of Connections</i> , The Physics Classroom (Dec. 01, 2011, 12:54 AM), https://www.physicsclassroom.com/Class/circuits/u9l4b.cfm [https://web.archive.org/web/20111201005447/https://www.physicsclassroom.com/Class/circuits/u9l4b.cfm]
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EX1024	Nave-2	Wayback Machine capture of Rod Nave, <i>Relaxation Oscillator Concept</i> , HyperPhysics (May 1, 2001, 4:38 AM), http://hyperphysics.phy-astr.gsu.edu/hbase/electronic/relaxo.html [https://web.archive.org/web/

Exhibit	Shorthand	Description
		20010501043853/http://hyperphysics.phy-astr.gsu.edu/hbase/electronic/relaxo.html]
EX1025		Claim Construction Order, <i>Jiaxing Super Lighting Electric Appliance Co., Ltd. v. MaxLite, Inc.</i> , No. 2:19-cv-04047-PSG-MAA, Dkt. No. 117 (C.D. Cal. May 27, 2021)
EX1028		Plaintiffs Jiaxing Super Lighting Electric Appliance Co., Ltd., and Obert, Inc.'s Preliminary Infringement Contentions, Claim Chart B1, <i>Jiaxing Super Lighting Elec. Appliance Co., Ltd. v. Current Lighting Solutions, LLC d/b/a GE Current</i> , No. 6:22-CV-00534-ADA (W.D. Tex. Oct. 19, 2022)
EX1029		Plaintiffs Jiaxing Super Lighting Electric Appliance Co., Ltd., and Obert, Inc.'s Preliminary Infringement Contentions, Claim Chart B2, <i>Jiaxing Super Lighting Elec. Appliance Co., Ltd. v. Current Lighting Solutions, LLC d/b/a GE Current</i> , No. 6:22-CV-00534-ADA (W.D. Tex. Oct. 19, 2022)
EX1030		Declaration of Sylvia D. Hall-Ellis, Ph.D.
EX1031		Declaration of Nathaniel E. Frank-White of the Internet Archive
EX1032	Hsia299	U.S. Patent No. 8,979,299
EX1033		Wayback Machine capture of <i>Catalog of Standards UL 1993 Self-Ballasted Lamps and Lamp Adapters</i> , Underwriters Laboratories (Jan. 21, 2014, 8:37 AM), http://www.ul.com/global/eng/pages/solutions/standards/accessstandards/catalogofstandards/standard/?id=1993_4 [https://web.archive.org/web/20140121083748/http://www.ul.com/global/eng/pages/solutions/standards/accessstandards/catalogofstandards/standard/?id=1993_4]

I. INTRODUCTION

1. My name is Michael Lebby. I have been retained by Current Lighting Solutions, LLC d/b/a GE Current (“Current Lighting”) as an independent expert in the relevant art.

II. PROFESSIONAL BACKGROUND

2. I earned a Doctor of Philosophy (Ph.D) in 1987 from the University of Bradford, United Kingdom (UK). My Ph.D. thesis involved the design and fabrication of both optoelectronic and electronic semiconductor devices, and their associated characterization.

3. In 2004, I was awarded a Doctor of Engineering (D.Eng.) degree (a higher doctorate degree) from University of Bradford for my technical contributions to the field, with citation to “Technical Contributions to Optoelectronics.”

4. I also earned a Master of Business Administration (MBA) in 1984 and a Bachelor of Engineering (B.Eng.) in 1985, both from the University of Bradford. For my B.Eng. degree, I wrote my thesis on the computer aided testing of semiconductor devices.

5. I am a technologist and an internationally-recognized business leader with nearly 40 years of experience working in integrated photonics, electronics, and optoelectronics design and manufacturing. I am serving as an expert in the field of electronics and lighting technologies, including light-emitting diodes (LEDs).

6. Throughout the course of my educational and professional activities, I have worked extensively with devices like the LED devices and electronics at issue in this case. In general, I have worked in nearly every aspect of the optoelectronics and electronics business, ranging from epitaxial wafer growth, device design using modeling and simulation, device fabrication, circuit-design, testing, and qualification, to the implementation of devices into packages, both hermetic and non-hermetic, as well as analysis of package materials such as plastics (including plastic housings such as resin-packaged lead frame housings), metallic-based packages, semiconductor-based packages, ceramic-based packages, and printed circuit board electronics. I have also designed device packages (through-pin, surface mount, flip-chip, and various combinations thereof) for printed circuit board mounting. Many of the designed packages were implemented into modules and sub-system/luminaire applications. The modules have included fiber-optic, electronics, display, lighting, and sensing-based technologies.

7. I have also worked in commercially based industrial research-and-development laboratories to bring new optoelectronic, electronic, and photonic-based technologies from the research proof-of-concept phase through prototyping and qualified manufacturing for volume release. I have been both an entrepreneur (*e.g.*, Ignis Optics Inc, One Chip Photonics Inc., Lightwave Logic Inc.), as well as an intrapreneur (*e.g.*, Motorola, Intel, TE Connectivity (previously Tyco Electronics,

and AMP), AT&T Bell Labs). In these roles I created innovative new programs, both as entrepreneurial venture backed start-ups as well as intrapreneurial corporate funded programs/divisions. I have built these entities to develop electronics, optoelectronics, and photonics technology emerge from the laboratory and fabrication clean room to production factories.

8. I currently serve as CEO of Lightwave Logic Inc, a public company.

9. I also currently serve as a Technical Expert to the European Commission, where my work has focused on LEDs, displays, lighting, organic LEDs (OLEDs), photonics devices, and other optical devices.

10. In academia, I have served as a professor of optoelectronics at Glyndŵr University, Wales, UK. Google Scholar currently assigns me an h-index of 47, an i10-index of 168, and over 8700 citations.

11. With regard to professional organizations, I serve as a Fellow of the National Academy of Inventors (NAI), the Institute of Electrical and Electronic Engineers (IEEE), and the Optical Society of America (OSA).

12. I regularly speak at technical conferences and have appeared in panels and interviews many times. I have served as chairman of the International PIC conference based in Europe since its conception in 2015.

13. I am a co-inventor of the first oxide vertical cavity surface emitting laser (VCSEL), which is now implemented in various consumer applications,

including Apple's iPhone Face ID feature and PC laser mice. This invention issued on 25th October, 1994, as U.S. Patent No. 5,359,618, entitled "High Efficiency VCSEL and Method of Fabrication".

14. In addition, I have over 230 issued utility patents with the USPTO in subjects such as electronics, optoelectronics, photonics, packaging, transceiver modules, optical sub-assemblies, materials, epitaxial growth, device design, assembly, and various active and passive components (both electronic and optoelectronic).

15. My CV, which is appended as Appendix A to this declaration, includes a listing of patents applications on which I am an inventor.

16. Because of my background, training, and experience, I am qualified as an expert to explain the background of the technology encompassed by the '174 Patent as well as to opine on the validity of the claims of the '174 Patent in view of the prior art references discussed herein.

III. COMPENSATION

17. My work on this matter is being billed at my customary rate of \$450.00 per hour. Also, I am being reimbursed for reasonable expenses I incur in relation to my services. I will be paid regardless of the outcome of any proceeding that my work is used in.

IV. OVERVIEW OF TASK & BASIS FOR OPINIONS

18. I have been asked to review the '174 Patent. I have been asked to provide opinions related to certain issues from the perspective of a person of ordinary skill, having knowledge of the relevant art, as of April 29, 2015, the earliest claimed priority date ("ECPD"), and—except where otherwise noted—the opinions stated in this declaration are from that perspective. The qualifications and abilities of such a person are described in §V below.

19. More particularly, I have been informed that this proceeding is currently at a preliminary stage during which the Patent Trial and Appeal Board will decide whether the Petition establishes a reasonable likelihood of at least one claim of the '174 Patent being unpatentable.

20. My opinions are based on my education, training, and experience as well as items that I reviewed to prepare my opinions, including the documents listed in the Exhibit List included with the Petition and any other items I reference in my below analysis.

21. I have not been asked to take a position on whether a given claim would have been legally obvious to a POSITA at the time of the alleged invention, but I have been told that some or all of my opinions are being used to support the argument that claims of the '174 Patent are obvious.

22. I understand that other issues may arise that require further explanation, and I will provide that explanation if appropriate. As a result, I respectfully reserve the right to update and supplement this declaration and the information and opinions provided herein.

V. LEVEL OF SKILL IN THE RELEVANT ART

23. I understand that the level of ordinary skill may be reflected by the prior art of record, and that a person of ordinary skill in the art (“POSITA”) to which the claimed subject matter pertains would have the capability of understanding the scientific and engineering principles applicable to the pertinent art.

24. I understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and experience of persons working in the field at the time of the invention; (2) the sophistication of the technology; (3) the types of problems encountered in the field; (4) the prior art solutions to those problems; and (5) the rapidity with which innovations are made.

25. A POSITA as of April 29, 2015—the ECPD—would have had at least a bachelor’s degree in electrical engineering or a comparable field and 3 years of experience designing lighting fixtures or systems, or equivalents. More education could have compensated for less experience, and vice versa. Such a POSITA would

have been familiar with the concepts and types of LED lighting technology described below.

26. Under this definition, I at least possessed ordinary skill in the art at the ECPD. I have applied this definition of a POSITA in rendering my opinions below.

VI. OVERVIEW OF THE TECHNICAL FIELD

27. LED tube lamps are LED lighting devices that are used in place of fluorescent tube lamps. LED light sources can be disposed inside tubes made to retrofit into existing fluorescent light sockets or fixtures. Premier, 1-3; *see, e.g.*, Ivey⁸¹³, 2:50-54.

28. Such preexisting fluorescent light sockets and fixtures include devices called ballasts, which start and maintain the light output of a fluorescent tube lamp. Premier, 3. Ballasts are essential to allowing fluorescent lights to work. Premier, 3.

29. LED tube lamps, however, do not require a ballast to operate and thus, in order to allow an LED tube lamp to retrofit into a fluorescent light socket or fixture, the existence of the ballast must be dealt with. Premier, 3. Several solutions have historically existed. A first solution is to include an integrated LED driver that operates on an existing ballast. Hsia⁶⁶¹, ¶[0006]; Premier, 3. Tube lamps that include such drivers are known as “Type A” LED tube lamps. Premier, 3. Such drivers allow the LED tube lamp to be plugged directly into the fluorescent light socket or fixture without any additional setup, creating a simple installation process.

Hsia661, ¶[0006]; Premier, 3. The tradeoff, however, is that, by utilizing the ballast, the LED tube lamp's operation thus becomes contingent on the lifespan of the ballast, increasing maintenance costs, while also reducing energy efficiency. Hsia661, ¶[0006]; Premier, 3.

30. An alternative solution is to bypass the ballast and connect directly to mains. Hsia661, ¶¶[0006]-[0007]; Premier, 3-4; *see, e.g.*, Sadwick, ¶[0173]. Such ballast-bypass LED tube lamps are known as “Type B” LED tubes. Premier, 3-4. By bypassing a ballast, type B tubes thus provide numerous significant benefits, including lowering maintenance costs and increasing energy efficiency. Hsia661, ¶¶[0006]-[0007]; Premier, 3-4. A number of tradeoffs exist, however, including requiring modifications to the fluorescent light socket or fixture, which makes setup more complicated—and potentially dangerous—when compared to Type A tubes. Premier, 3-4; Hsia661, ¶¶[0006]-[0007].

31. One particular tradeoff is that, by connecting directly to mains line power, installation of the type B tube becomes potentially dangerous, as the user may be accidentally exposed to mains and receive a shock. Such a risk exists not only when rewiring the fluorescent light fixture or socket itself (*e.g.*, Premier, 3-4), but also when simply relamping a type B tube (*e.g.*, Ivey345, ¶[0005]; Sadwick, ¶[0071]). Specifically, during relamping, should only one end of the tube be installed into the now mains powered fixture or socket, the exposed pins on the other

end of the tube may become powered on or hot. Ivey345, ¶[0005]; Sadwick, ¶[0071]. When touched by a user that is grounded, the user would thus be shocked, potentially fatally. Ivey345, ¶[0005]; Sadwick, ¶[0071].

32. Solutions to address the shock hazard from such a fault configuration already existed by the ECPD. For example, Ivey345 and Sadwick, discussed in further detail in §VIII below, each teach implementing a shock protection circuit specifically designed to detect and prevent the fault configuration above from occurring by periodically detecting voltage across or current through the tube lamp using a test resistor and, when such varies below an expected threshold due to the addition of a human (and thus resistance) to the circuit, preventing the tube from being powered on. Ivey345, ¶[0010]; Sadwick, ¶[0080].

VII. '174 PATENT

A. Overview

33. The '174 Patent discusses the shock hazard associated with the fault configuration above and discloses, as a solution, an “installation detection circuit” configured in an LED tube lamp to prevent a user from being electrically shocked during relamping. '174 Patent, 2:54-59, Abst., 6:52-65. One embodiment of such an installation detection circuit is depicted in Figure 15B:

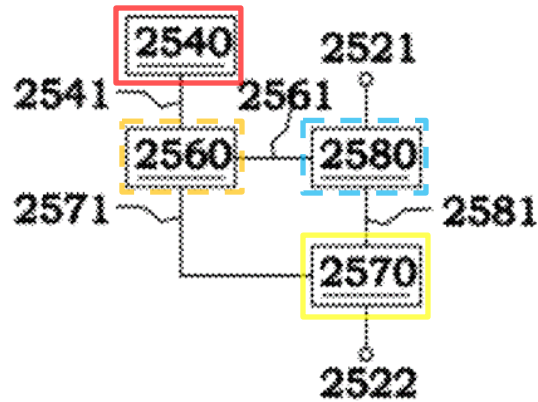


Fig. 15B

'174 Patent, Fig.15B,¹ 38:60-62. The depicted installation detection circuit includes a detection pulse generating module 2540 (solid-red), which periodically outputs a pulse signal to pulse signal output terminal 2541. '174 Patent, Fig.15B, 38:62-65, 39:1-4, 4:5-18. Figure 15C depicts an exemplary embodiment of a detection pulse generating module 2640:

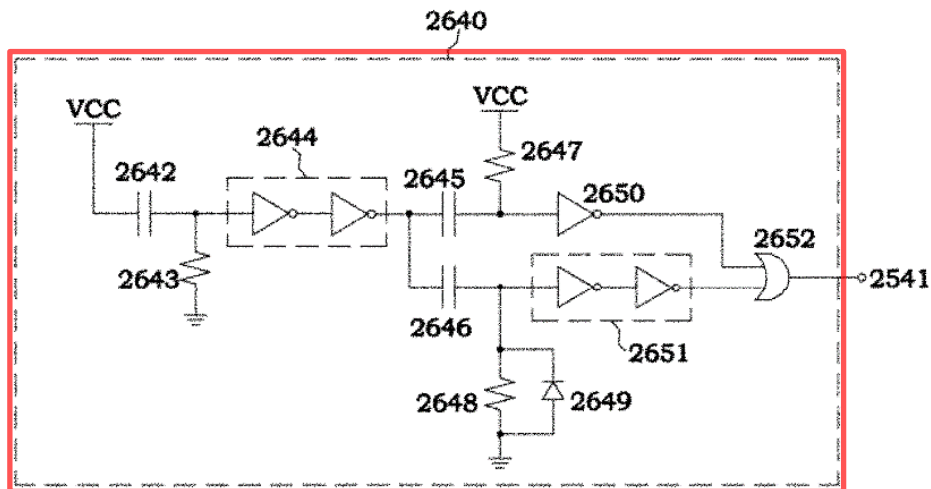


Fig. 15C

¹ All colorized figures are annotated.

'174 Patent, Fig.15H, 40:26-32.

34. The pulse signal is received by detection result latching circuit 2560 (dotted-orange), which may use the pulse signal as “a time point” for when to store a “detection result signal” received at its detection result terminal 2571. '174 Patent, Fig.15B, 39:12-27, 39:4-8. Detection result latching circuit 2560 outputs the stored detection result via detection result latching terminal 2561 ('174 Patent, Fig.15B, 39:12-27) and, in some embodiments, may also store and output the pulse signal itself ('174 Patent, 41:48-58, 39:65-40:1). Figure 15E depicts one such embodiment of a detection result latching circuit 2660:

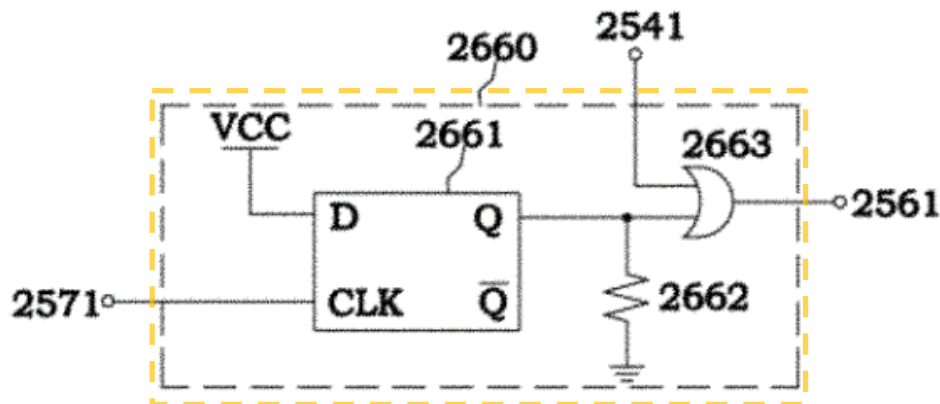


Fig. 15E

'174 Patent, Fig.15E, 43:38-44:13.

35. At the receiving end is switch circuit 2580 (dotted-blue), which controls the conducting state across the LED tube lamp. '174 Patent, Fig.15B, 39:12-30, 39:65-40:3. Thus, when detection result latching circuit 2560's output is high (such as when the stored detection result is high and/or, in some embodiments, when the

pulse is high), the switch circuit 2580 closes. '174 Patent, 39:65-40:3. Figure 15F depicts one embodiment of a switch circuit 2580:

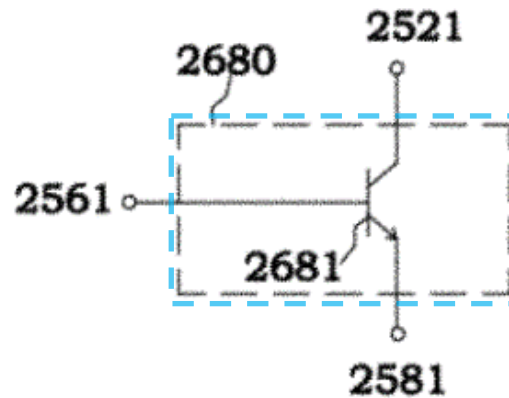


Fig. 15F

'174 Patent, Fig.15F, 44:15-40.

36. Lastly, the detection determining circuit includes detection determining circuit 2570 (solid-yellow), which detects a “sampling signal” such as current across the LED tube lamp and detects whether such current “is above or below a specific current value.” '174 Patent, Fig.15B, 39:8-11, 40:2-8. When the LED tube “is correctly installed on a lamp socket,” such current will be above the specific current value, and detection determining circuit 2570 will output a “high logic level” detection result signal to detection result latching circuit 2560 over detection result latching terminal 2561. '174 Patent, 43:11-30. The opposite occurs “when the LED tube lamp is incorrectly installed on the lamp socket or one end cap thereof is inserted into the lamp socket but the other one is grounded by an object such as a

human body.” ’174 Patent, 43:31-37. Figure 15D depicts one embodiment of a detection determining circuit 2670:

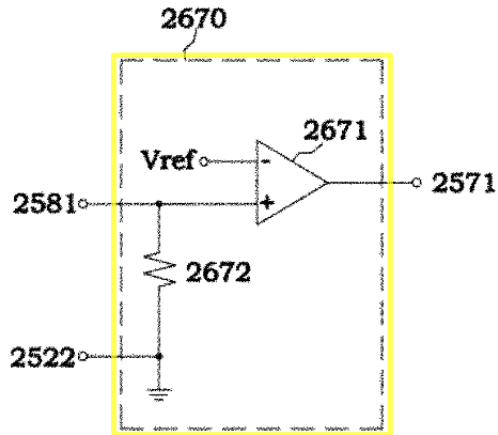
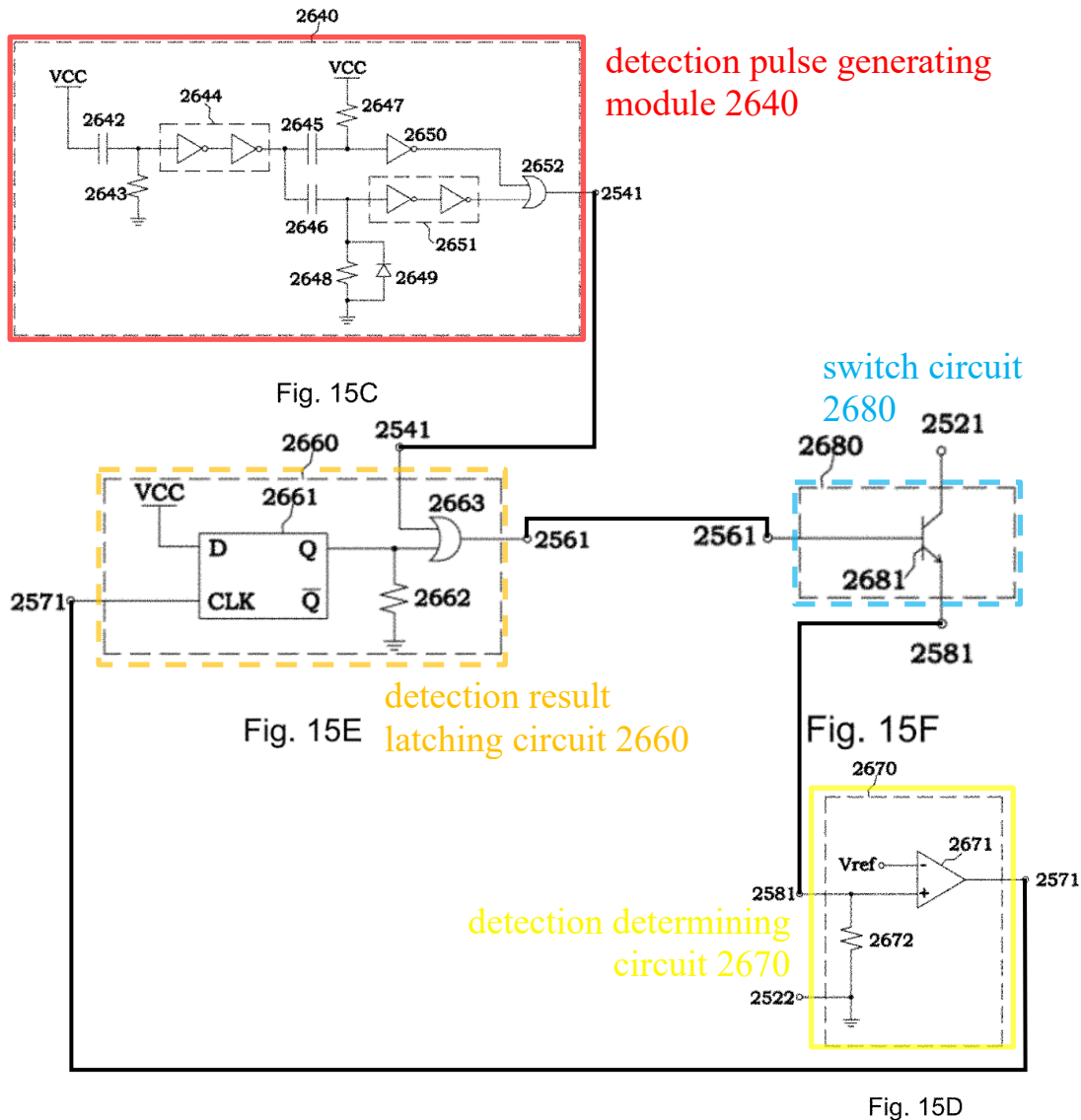


Fig. 15D

’174 Patent, Fig.15D, 43:1-37.

37. In accordance with Figure 15B and the above discussion, Figures 15C-15F may be combined to form the installation detection circuit depicted below:



38. Additionally, the '174 Patent depicts another installation detection circuit embodiment in Figure 15G with a similar layout and operation as that depicted in Figure 15B, but where pulse generating module 2740 (solid-red) receives the output of detection result latching circuit 2760 (dotted-orange) as feedback to enable pulse generating module 2740 to “not generate any pulse signal while the power loop remains conductive”:

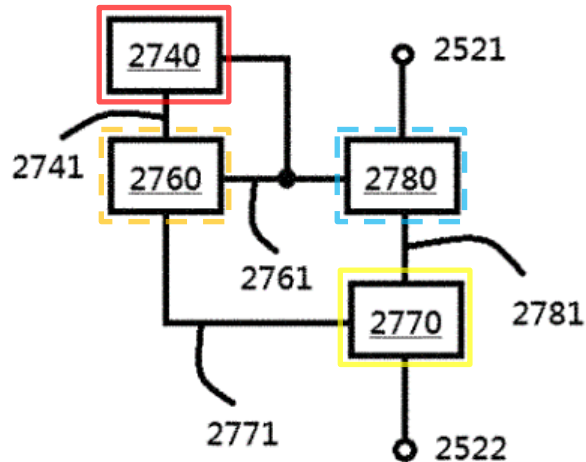


Fig. 15G

'174 Patent, Fig.15G, 52:3-52.

B. Claim Construction

39. For purposes of this IPR, I apply the common and ordinary meanings of claim terms in the '174 Patent. At this time, all terms should be given their plain and ordinary meaning.

1. “*detection result latching circuit*”

40. Claims 17 and 27 recite a “detection result latching circuit.” I understand that, in the *Maxlite* Action, the court interpreted the term to mean “circuit that reverses its signal level when the detected result *or pulse signal from the detection pulse generating module* is applied and maintains its signal level based on the detected result.” EX1025, 26-28.²

² All emphasis added unless otherwise indicated.

41. I disagree with the *Maxlite* Court’s interpretation, particularly the emphasized portion above. The claims contain no requirement that the detection result latching circuit necessarily outputs a reversed signal level when receiving a pulse signal from the claimed “pulse generating module.” In fact, the ’174 Patent explains that, in some embodiments, the pulse signal can be received by the detection result latching circuit simply “to inform the detection result latching circuit 2560 of a time point for latching (storing) the detection result.” *E.g.*, ’174 Patent, 39:12-16. The *Maxlite* Court’s construction is thus too restrictive. For purposes of this IPR, the term should instead be given its common and ordinary meaning.

VIII. COMPARISON OF PRIOR ART TO THE ’174 PATENT’S CHALLENGED CLAIMS

A. Ground 1: Ivey813, Ivey345, and UL1993, and Claims 1, 3-4, 21-28, 30-31, and 35

1. Ivey813

42. Ivey813 describes “a light emitting diode (LED) based light tube,” particularly “a circuit board mount for the LED light tube and methods of mounting the circuit board.” Ivey813, 1:13-16. Ivey813’s Figure 1 depicts an example:

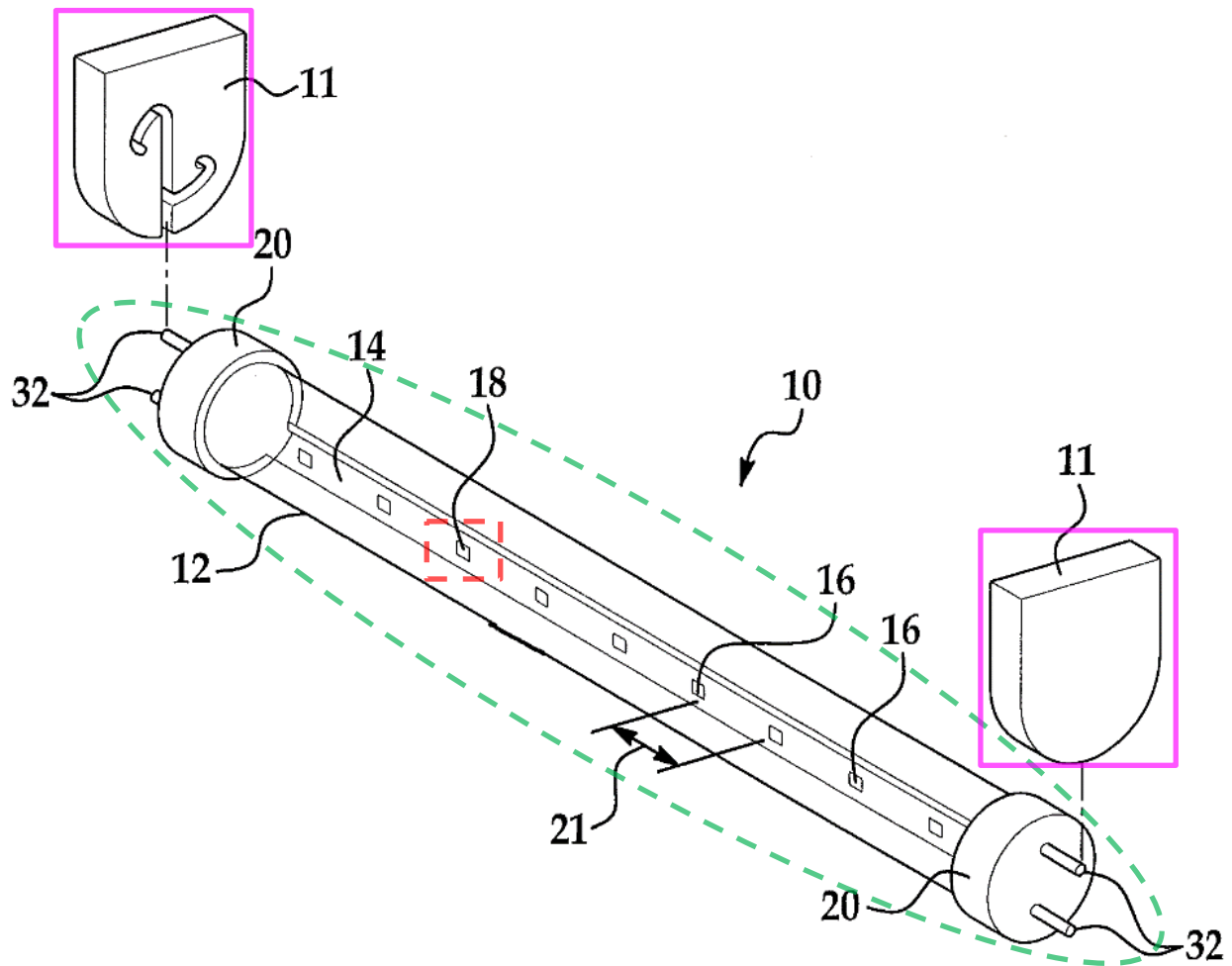


FIG. 1

Ivey813, Fig.1. As Ivey813 teaches, Ivey813's Figure 1 depicts LED light tube 10 (dotted-green) comprising an elongated housing 12 with two end caps 20 attached at opposing ends of housing 12. Ivey813, 1:37-39, 1:50-51. Each end cap 20 includes pins 32, each of which electrically connect the LED light tube to fixture 11 (solid-pink) or act as a "dummy pin" that does not provide an electrical connection." Ivey813, 5:1-16. As a POSITA would have recognized, fixture 11 can be, "for example, an existing fluorescent lamp fixture" and thus "can contain a ballast," or can instead directly power the LED light tube 10 with mains line power, such as

when the LED light tube 10 is a ballast-bypass (type B) LED tube. *See* Ivey813, 2:51-56; Premier, 3-4; '174 Patent, 2:60-3:3; Hsia661, ¶[0006]. Separately, a POSITA would have also been motivated to modify LED light tube 10 to be a type B LED tube, because such would have allowed LED light tube 10's operation to be no longer contingent on a ballast, thereby increasing power efficiency and reducing maintenance cost. *See* Hsia661, ¶¶[0006]-[0008] (“In the long run, ballast-compatible [LED tube] lamps are more expensive and less efficient than self-sustaining AC mains-operable [LED tube] lamps.”); Premier, 3-4. And a POSITA would have known how to perform such a modification. *See* '174 Patent, 2:60-3:3 (“**Currently**, LED tube lamps used to replace traditional fluorescent lighting devices can be primarily categorized into two types. One is for ballast-compatible LED tube lamps...; and the other one is for ballast by-pass LED tube lamps...”); Hsia661, ¶[0006] (same, reworded).

43. The LED light tube 10 also comprises circuit board 14 spanning housing 12. Ivey813, 1:37-39. Circuit board 14 has LEDs 18 (dotted-red) mounted to its surface and conductive connections from the pins 32 to the LEDs 18. Ivey813, 2:13-17, 3:27-37, 3:63-67.

44. Circuit board 14 also includes power converter 36 (solid-brown) near end caps 20 to “convert the power received through the fixture [via the pins] into power usable by and suitable for the LEDs”:

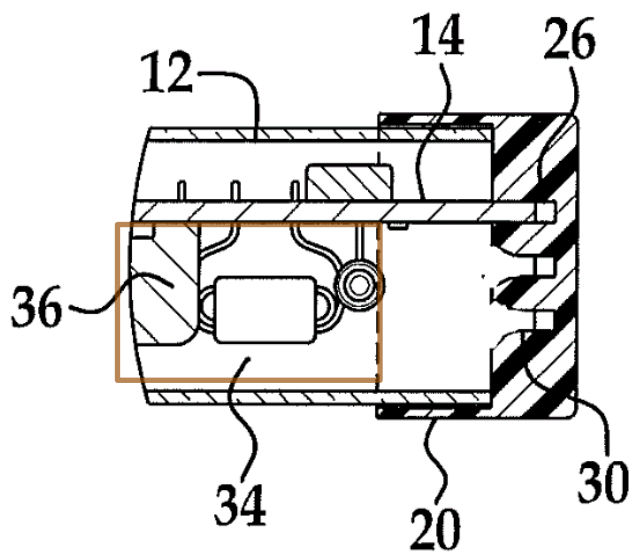


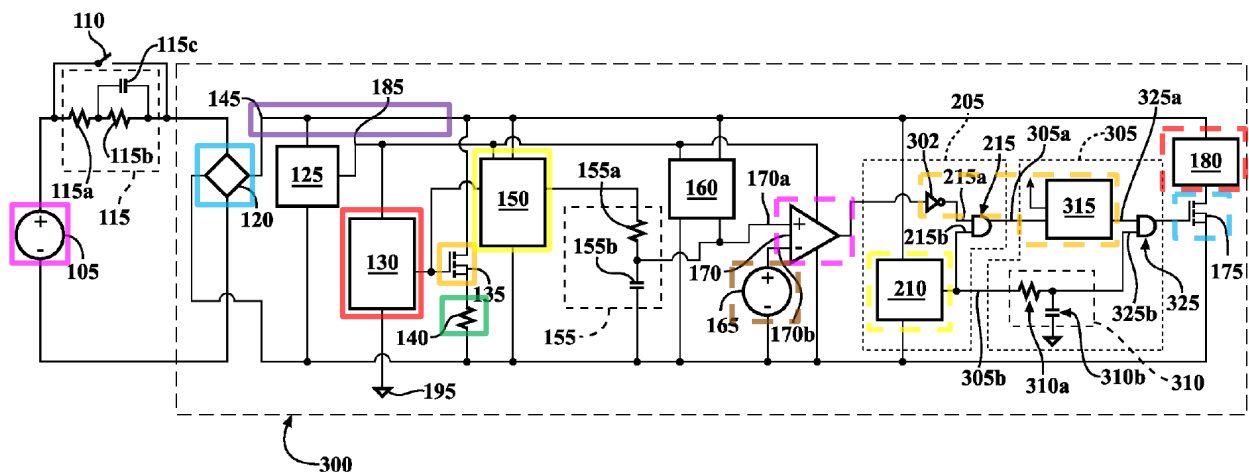
FIG. 7

Ivey813, Fig.7, 5:31-35. Power converter 36 includes “one or more of an inrush protection circuit, a surge suppressor circuit, a noise filter circuit, a rectifier circuit, a main filter circuit, a current regulator circuit and a shunt voltage regulator circuit.” Ivey813, 5:36-39.

2. *Ivey345*

45. Ivey345, which shares the same inventor as Ivey813, is directed to “a system and method for protecting a person from electrical shock when interacting with an electrical device.” Ivey345, ¶[0002], code (72); Ivey813, code (75). As Ivey345 teaches, “[c]ompact fluorescent light bulbs (CFLs) and light emitting diode based (LED-based) lights are gaining popularity,” but such “line-powered electrical devices” also carry certain “drawbacks.” Ivey345, ¶[0004]. Particularly, “if the power terminal is connected using one connector and the subject, for example a

person installing a new bulb, comes into contact with the return terminal in another connector that has not yet been mated, the person may receive a shock by completing the circuit from the return terminal to ground.” Ivey³⁴⁵, ¶[0005].



Ivey345, Fig.3. Here, power input 105 (solid-pink) delivers AC line power to current limiting circuit 300, which includes rectifier 120 (solid-blue) to rectify the power “from an AC wave to a DC wave.” Ivey345, ¶¶[0015], [0020], [0041]. The rectified DC power is provided to device power rail 145 (purple) that connects to

main load 180 (dotted-red), which “may be an LED-based light.” Ivey345, ¶¶[0016], [0037].

47. Load switch 175 (dotted-blue) controls whether current may flow from rectifier 120 and device power rail 145 through main load 180. Ivey345, ¶¶[0010], [0045]. In a “fault configuration” where power input 105 and the current limiting circuit are connected “through a subject, for example, a person’s body” (represented by human body resistor-capacitor model 115), load switch 175 “remains off” to prevent current flow through main load 180, “thereby maintaining the current flowing through the subject at a low and safe level.” Ivey345, ¶¶[0013], [0010], [0035]-[0036], [0045]. “For example, a maximum current that can pass through an electrical load simulating the human body may be provided by safety standards promulgated by nationally recognized testing labs.” Ivey345, ¶[0023]. By contrast, in a “normal circuit configuration” where power input 105 and the current limiting circuit are “connected directly” (represented by the closing of “switch 110”), load switch 175 remains closed, allowing main load 180 to remain powered on. Ivey345, ¶¶[0013], [0010], [0035]-[0036], [0045].

48. Ivey345’s current limiting circuit includes auxiliary power supply 125, which is directly powered by rectifier 120 and provides, e.g., a standard 5V digital supply voltage; and oscillator 130 (solid-red), which is powered by auxiliary power supply 125. Ivey345, ¶¶[0016]-[0017], [0019]. “[O]scillator 130 may be configured

as a harmonic-type oscillator or a relaxation-type oscillator, a crystal oscillator, a ring oscillator, a silicon micromechanical resonator, an oscillating output of a digital circuit or microprocessor, or any other type of oscillator.” Ivey345, ¶[0019].

49. Oscillator 130’s output is “electrically connected to an input of [a] test load switch 135 [(solid-orange)], such that the test load switch 135 is controlled by the oscillator 130.” Ivey345, ¶¶[0021]-[0022], [0024]. Test load switch 135 is connected to device power rail 145 and Z test load 140 (solid-green) such that, while test load switch 135 is closed by oscillator 130’s output, current is permitted to flow from device power rail 145 through Z test load 140. Ivey345, ¶¶[0021]-[0024].

50. An auxiliary-powered detector 150 (solid-yellow), which also receives oscillator 130’s clock signal and thus operates synchronously with test load switch 135’s activation, “detect[s] a variation in the current draw or voltage across the device power rail 145 due to the oscillating change in the current going through the Z test load 140” and “output[s] a signal in response to a change in the current of the Z test load 140.” Ivey345, ¶¶[0024]-[0027]. Detector 150’s output signal is “a voltage, current, or other type of signal” that “decreases as the variation in the device power rail 145 increases” (i.e., a fault configuration) and “increases as the variation in the device power rail 145 decreases” (i.e., a normal configuration). Ivey345, ¶¶[0024]-[0027], [0010].

51. Detector 150's output signal is noise-filtered by detector low pass filter 155 and then sent to the non-inverting input of an auxiliary-powered comparator 170 (dotted-pink). Ivey345, ¶¶[0028]-[0029], Fig.3. Comparator 170 also receives the output of detection threshold signal source 165 (dotted-brown) at comparator 170's inverting input, compares these two inputs, "and produces an output relating to the comparison." Ivey345, ¶[0030], Fig.3. Specifically, if detector 150's output signal is lower than the threshold signal (corresponding to a fault configuration), comparator 170 outputs a "low" signal, and vice versa. Ivey345, ¶¶[0030]-[0032].

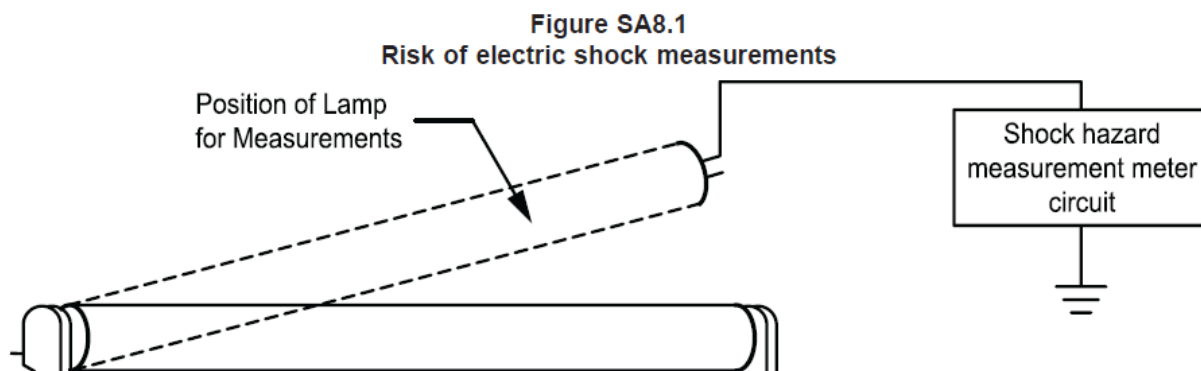
52. Comparator 170's output is inverted by logic inverter 302 and then eventually sent to "main load shut-off latch 315" (together in dotted-orange), which "may be constructed from an electrical flip-flop" and, although not depicted in Figure 3, may be synchronized with oscillator 130's clock signal. Ivey345, ¶¶[0041]-[0043]. Before reaching latch 315, however, the inverted comparator output is first inputted into detection logic circuit 215—an AND gate, which receives its second input from detection validation timer 210 (dotted-yellow). Ivey345, ¶¶[0040]-[0041]. Timer 210 "outputs a 'low' signal initially and outputs a 'high' signal after an amount of time has lapsed." Ivey345, ¶[0038]. Thereafter, detection logic circuit 215 passes the inverted comparator output into latch 315's clock input, which controls whether latch 315 "should accept a state change." Ivey345, ¶[0044]-[0045], [0039]-[0041].

53. The output of latch 315 is connected to main load detection logic circuit 325—another AND gate, which is located at load switch 175’s input. Ivey345, ¶¶[0035]-[0036], [0045]-[0046], [0010]. Initially, “main load shut-off latch 315 starts at power-up in the ‘on’ state, which would normally energize the main load 180.” Ivey345, ¶[0045]. “However, the output of main load logic detection circuit 325 is initially off,” because main load logic detection circuit 325 receives its second input from timer 210. Ivey345, ¶[0045]. Such ensures at startup that “no subject is detected in the electrical circuit” for a “detection valid time” before load switch 175 is allowed to turn on. Ivey345, ¶¶[0045], [0038]-[0039]. If a normal configuration is maintained thereafter, then main load 180 will be energized, as latch 315 will receive a low inverted comparator output signal that will cause latch 315 to continue in the “on” state and pass a high output to load switch 175 through main load logic detection circuit 325. Ivey345, ¶¶[0045]-[0046], [0030]-[0032]. If a fault configuration is detected at any time, however, latch 315 will instead receive a high inverted comparator output signal and thus change to an off state, thereby “latching a low output” and “disabling” load switch 175 until “power is removed from the circuit and reapplied.” Ivey345, ¶¶[0044]-[0046], [0041], [0030]-[0032].

3. UL1993

54. From my personal experience, I recognize UL1993 to be a consumer safety standard for LED tube lamps. *See* UL1993, 1; *see also, e.g.*, Hsia299, 6:21-

25. The '174 Patent itself confirms this. '174 Patent, 51:10-12 (acknowledging “*the* UL standard to make the leakage current of the LED tube lamp less than 5 MIU”). UL1993 mandates, regarding the “[r]isk of electric shock [during] relamping,” that leakage current “shall not exceed 5 M.I.U[.]” when one end of the tube is powered while the other end is “considered accessible and... connected to [a] shock hazard measurement meter circuit and, in turn, to earth ground as shown in Figure SA8.1[:].”



UL1993, 92-93; '174 Patent, 51:10-12.

55. UL1993’s stated date of publication is December 4, 2012. UL1993, 3. In my experience, UL standards were available for download from, and easy for a POSITA to locate on, the UL website on or shortly after their stated publication dates. I consulted the Internet Archive and confirmed that this was true for UL1993 through the following URL of an archived UL website page: https://web.archive.org/web/20140121083748/http://www.ul.com/global/eng/pages/solutions/standards/accesstandards/catalogofstandards/standard/?id=1993_4 (shown in EX1033). This URL shows that UL1993 was accessible from at least

<http://www.ul.com> on January 21, 2014; I understand how to read the URL from Archive at ¶5. I compared the “Table of Contents” shown on the webpage (EX1033, 1-4) to UL1993’s table of contents (UL1993, 9-12), and, to the best of my knowledge, the two match, confirming UL1993 was publicly available on the UL website no later than around a year from its publication date and at least before the ECPD.

4. Rationale to Combine Ivey813 with Ivey345 and UL1993

56. Ivey813 describes an “LED light tube” that is, or a POSITA would have been motivated to make, mains line powered. Ivey813, 2:51-56; §VIII.A.1. And Ivey345 teaches improving “LED-based lights[] and other line-powered electrical devices” by implementing a “current limiting circuit” within such lights for “protecting a person from electrical shock” during relamping. Ivey345, ¶¶[0002], [0004]-[0005]. Thus, Ivey345 expressly teaches combining Ivey345’s current limiting circuit into a line-powered LED-based light, such as Ivey813’s mains line powered LED-based light tube, and therefore contains an express teaching, suggestion, and motivation to combine the two references. Indeed, Ivey345 names the same inventor as, but was filed two years after, Ivey813, suggesting that the inventor himself had intended for Ivey345’s current limiting circuit to be used to improve Ivey813’s LED-based light tube. Ivey345, ¶[0002], code (72); Ivey813, code (75).

57. Such modification also improves user safety. As Ivey345 states, LED-based lights and other line-powered devices carry certain “drawbacks,” namely that a subject user may be electrically shocked during relamping by contacting the bulb’s “return terminal” while the bulb’s “power terminal” is connected (fault configuration). Ivey345, ¶¶[0004]-[0005], [0013]; *accord* Premier, 4. Such a risk of shock is present in Ivey813’s LED-based light tube when mains line powered. *See* Premier, 4; Ivey813, 5:33-39. Ivey345, however, provides a solution by disclosing a “current limiting circuit” that detects whether the above fault configuration is present and, when such is detected, prevents the LEDs in the LED-based light bulb from being energized and thus the user from being shocked. Ivey345, ¶¶[0010], [0037]. Given such teachings, a POSITA would have thus been motivated to modify the line-powered version of Ivey813’s LED-based light tube by adding Ivey345’s current limiting circuit to power converter 36, because doing so would have enabled power converter 36 to additionally “convert the power received through the fixture” to “a low and safe level” when a fault configuration occurs, thereby improving user safety during relamping. *See* Ivey813, 5:33-35; Ivey345, ¶¶[0010], [0004]-[0005].

58. Regarding this “low and safe level,” Ivey345 further teaches that its current limiting circuit allows current to periodically flow despite a fault configuration, but “the total current drawn... is preferably less than a maximum safe

current to avoid harm to the subject. For example, a maximum current that can pass through an electrical load simulating the human body may be provided by safety standards promulgated by nationally recognized testing labs.” Ivey345, ¶[0023]. Such “safety standards” that a POSITA would have been aware of for practicing these teachings include UL1993’s “5 M.I.U[.]” limit for leakage current during relamping. UL1993, 92; ’174 Patent, 51:10-12. Even setting aside Ivey345’s explicit suggestion to turn to a safety standard like UL1993, a POSITA would have nevertheless been motivated to limit the fault-configuration current draw to UL1993’s 5MIU limit for compliance and safety purposes.

5. The Resulting “Ivey-UL1993 Combination”

59. So modified, the combination of Ivey813, Ivey345, and UL1993 (the “Ivey-UL1993 Combination”) comprises Ivey813’s “LED-based light tube,” which is mains line powered by fixture 11 (Ivey345’s power source 105) and utilizes Ivey345’s “current limiting circuit” as an additional circuit within power converter 36 to control whether current may flow from power converter 36’s rectifier circuit (Ivey345’s rectifier 120) through the tube’s LEDs 18 (Ivey345’s “main load 180”) based on the detected current draw or voltage across the tube (Ivey345’s device power rail 145). *See* Ivey813, 5:31-40; Ivey345, ¶¶[0024]-[0027], [0010]. If such detection indicates a fault configuration, current through the tube is limited to a

standard-compliant “low and safe level,” e.g., <5MIU. *See* Ivey345, ¶¶[0010], [0023]; ’174 Patent, 51:10-12, 2:32-37; UL1993, 92.

6. *Element-by-Element Analysis*

(a) **Limitation [18pre]:** A detection method for a light-emitting device (LED) tube lamp for preventing a user from electric shock when the LED tube lamp is being installed on a lamp socket, the detection method comprising:

60. The Ivey-UL1993 Combination utilizes, within power converter 36 of Ivey813's LED-based light tube, Ivey345's current limiting circuit that detects during relamping whether a subject user is making contact with the tube's return terminal while the tube's power terminal is connected to fixture 11 (Ivey345's power source 105 (solid-pink)) (claimed "lamp socket"):

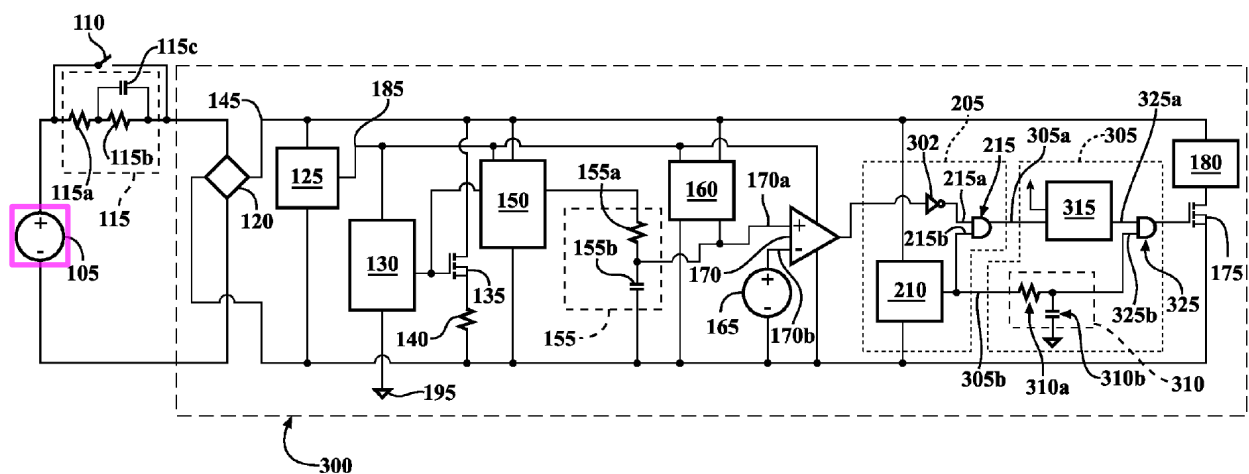


FIG. 3

Ivey813, 2:50-56, 5:33-35; Ivey345, Fig.3, ¶¶[0010], [0004]-[0005]; §VIII.A.5. If such is detected during relamping, the current limiting circuit “maintain[s] the current flowing through the subject at a low and safe level,” and thus performs the

claimed “detection method... for preventing a user from electric shock when the LED tube lamp is being installed on a lamp socket.” Ivey345, ¶¶[0010], [0004]-[0005].

(b) Limitation [18a]: generating a pulse signal by a detection pulse generating module;

61. Ivey345’s current limiting circuit includes oscillator 130 (solid-red), which outputs a clock signal (“pulse signal”) that oscillates high and low, e.g., “a digital, continuous time output, a varying sinusoidal output, or another type of output”:

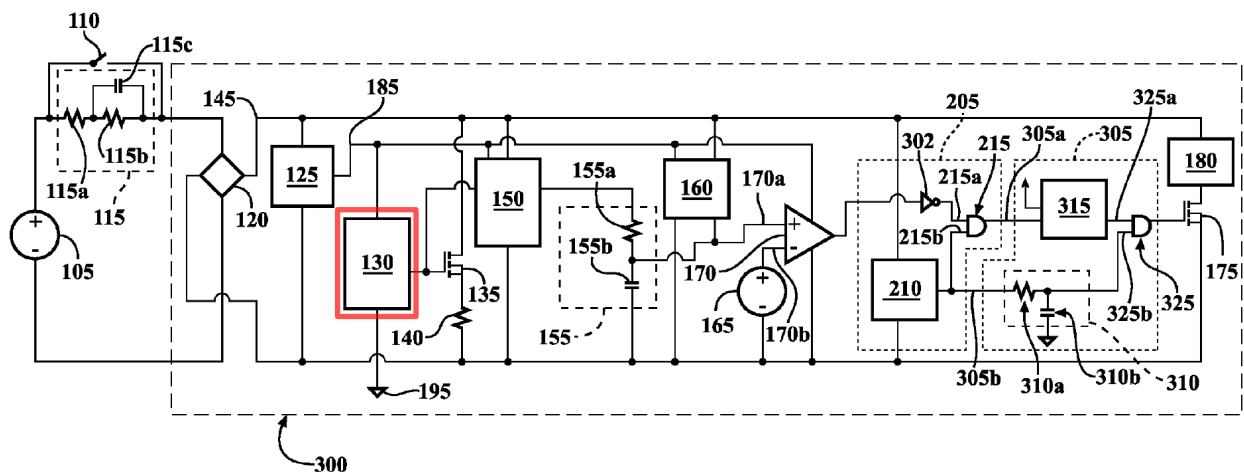


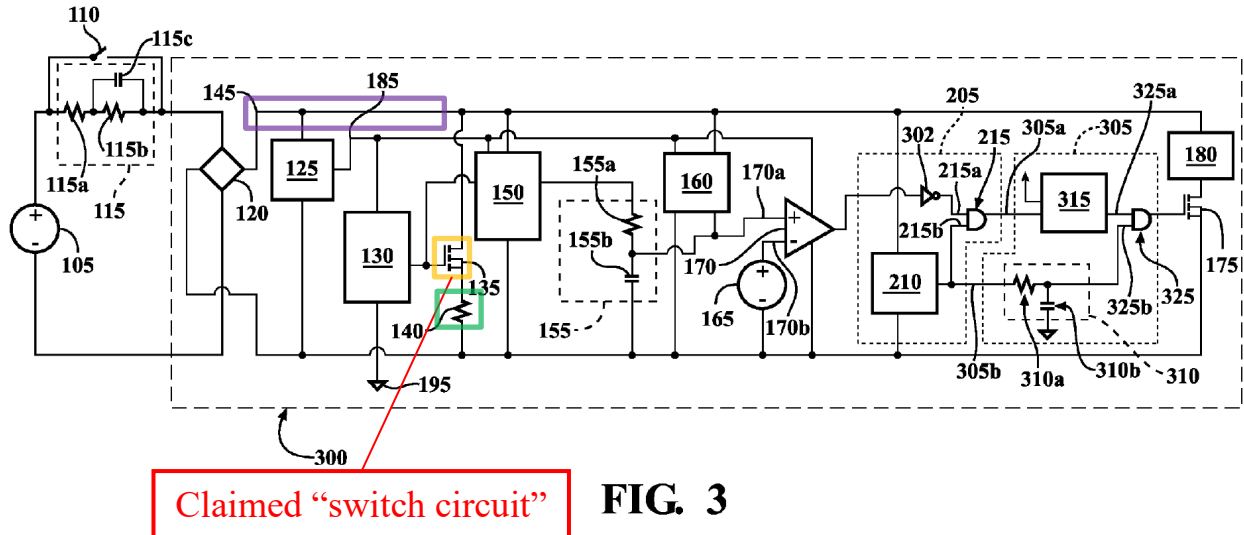
FIG. 3

Ivey345, Fig.3, ¶¶[0019], [0044]; *see also* '174 Patent, 41:44-48 (defining a “high logic level signal” as a “pulse signal”), 41:59-64 (defining a “low logic level signal” as the “stop[]” of the output of a pulse signal).

(c) Limitation [18b]: receiving the pulse signal by a switch circuit coupled on a power loop of the LED tube lamp,

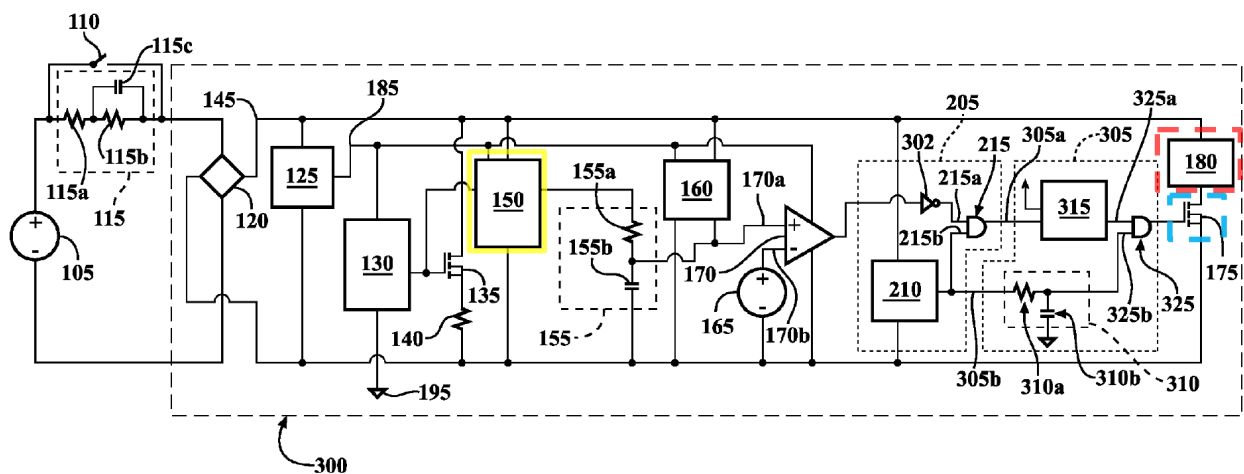
wherein the switch circuit is conducted during a pulse-on period of the pulse signal to cause the power loop to be conductive;

62. Ivey345's current limiting circuit includes test load switch 135 (solid-orange), which meets the claimed "switch circuit":



Ivey345, Fig.3, ¶¶[0010], [0021]-[0023]. Specifically, test load switch 135's gate receives oscillator 130's clock signal ("receiving the pulse signal by a switch circuit"), causing test load switch 135 to open and close as the clock signal oscillates low and high, respectively. Ivey345, ¶¶[0020]-[0022], [0024], Fig.3. Test load switch 135's drain and source are connected respectively to device power rail 145 (purple) ("coupled on a power loop of the LED tube lamp") and Z test load 140 (solid green), the latter of which connects to ground. Ivey345, ¶¶[0022]-[0024], Fig.3. Thus, while test load switch 135 is closed by oscillator 130's high output ("switch circuit is conducted during a pulse-on period of the pulse signal"), current

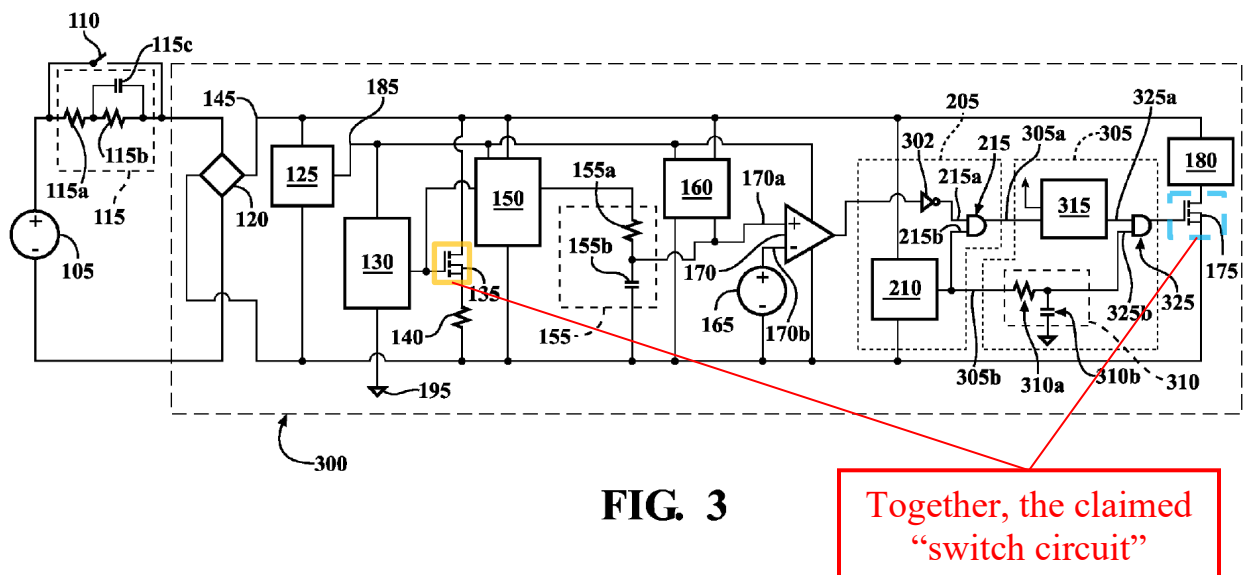
is permitted to flow from device power rail 145 through Z test load 140 to ground (“to cause the power loop to be conductive”). Ivey345, ¶¶[0022]-[0024], Fig.3.



Ivey345, Fig.3, ¶[0024]. While the clock signal oscillates high, test load switch 135 not only conducts (“receiving the pulse signal by a switch circuit coupled on a power loop of the LED tube lamp, wherein the switch circuit is conducted during a pulse-on period of the pulse signal”), but also allows detector 150 to “detect a variation in the current draw or voltage across the device power rail 145 due to the oscillating change in the current going through the Z test load 140.” Ivey345, ¶[0024]. This

detected variation is then used to detect whether a normal configuration exists, and, if such is detected, load switch 175 (dotted-blue) will remain on, allowing current to flow from device power rail 145 through main load 180 (dotted-red), i.e., the LEDs (“to cause the power loop to be conductive”). Ivey345, ¶¶[0010], [0024]-[0027], [0030]-[0032], [0037], [0044]-[0045]; *see also infra* §§VIII.A.6(d)-VIII.A.6(g).

64. As a second alternative, test load switch 135 and load switch 175 together also meet the claimed “switch circuit”:



Ivey345, ¶[0024]. Specifically, test load switch 135 receives oscillator 130’s clock signal (“receiving the pulse signal by a switch circuit coupled on a power loop of the LED tube lamp”). Ivey345, ¶¶[0022]-[0024]. As explained, such allows detection of whether a normal configuration exists, and if such is detected, load switch 175 will remain on (“wherein the switch circuit is conducted during a pulse-on period of the pulse signal”), allowing current to flow from device power rail 145 through the

LEDs (“to cause the power loop to be conductive”). Ivey345, ¶¶[0010], [0024]-[0027], [0030]-[0032], [0037], [0044]-[0045]; *see also infra* §§VIII.A.6(d)-VIII.A.6(g).

65. Regarding this second alternative, a POSITA would have understood that a plurality of separate transistor switches that perform the claimed functions would together meet the claimed “switch circuit.” ’174 Patent, 12:10-34; *see also, e.g.*, Digi-Key (showing numerous “2 N-Channel (Dual)” FET products—i.e., two n-type MOSFETs formed on one integrated *circuit*—were commercially available by the ECPD); Fairchild (datasheet for Fairchild Semiconductor FDG6303N, which is the first “2 N-Channel (Dual)” FET product listed in Digi-Key).

(d) Limitation [18c]: detecting a sampling signal on the power loop;

66. Ivey345’s detector 150 receives oscillator 130’s clock signal, more precisely, to synchronize detector 150’s operation with test load switch 135’s activation. Ivey345, ¶[0024]. While test load switch 135 is closed by oscillator 130’s clock signal, detector 150 “detect[s] a variation in the current draw or voltage across the device power rail 145” (“detecting a sampling signal on the power loop”) based on the current now passing through Z test load 140, and outputs a signal representative of the detected variation. Ivey345, ¶¶[0024]-[0027], claim 14.

(e) **Limitation [18d]: comparing the sampling signal with a predefined signal; and**

67. When Ivey345's detector 150 detects either an increase or decrease in the variation across device power rail 145 caused by a fault or normal configuration, respectively, detector 150 outputs a correspondingly "decrease[d]" or "increase[d]" signal to comparator 170 (dotted-pink):

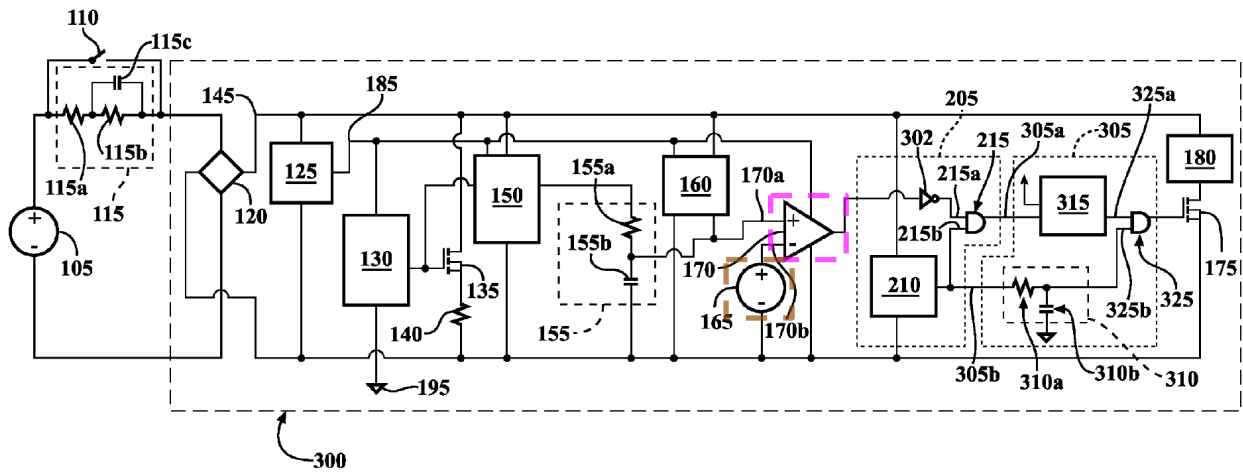


FIG. 3

Ivey345, Fig.3, ¶¶[0024]-[0026], [0010], [0028]-[0029], [0034]. Comparator 170 compares detector 150's output signal to a threshold signal from detection threshold signal source 165 (dotted-brown) ("comparing the sampling signal with a predefined signal") and "produces an output relating to the comparison." Ivey345, ¶¶[0030]-[0032].

- (f) Limitation [18e]: limiting a current on the power loop less than 5 MIU when a signal level of the sampling signal is smaller than the predefined signal.**

68. When the output signal of Ivey345's detector 150 is lower than the threshold signal (fault configuration) ("when a signal level of the sampling signal is smaller than the predefined signal"), comparator 170 outputs a "low" signal that ultimately causes load switch 175 to "remain[] off, thereby maintaining the current flowing through the subject at a low and safe level," e.g., <5MIU. Ivey345, ¶¶[0010], [0023], [0030]-[0032], [0044]-[0045]; §VIII.A.5.

- (g) Claim 19: The detection method according to claim 18, further comprising:
conducting the power loop when the signal level of the sampling signal is greater than or equal to the predefined signal.**

69. When Ivey345 detector 150's output signal is higher than the threshold signal (normal configuration) ("when the signal level of the sampling signal is greater than or equal to the predefined signal"), comparator 170 outputs a "high" signal that ultimately causes load switch 175 to remain on, allowing current to flow from device power rail 145 through the LEDs ("conducting the power loop"). Ivey345, ¶¶[0010], [0030]-[0032], [0041], [0044]-[0045].

(h) Limitation [10pre]: A ballast by-pass light-emitting diode (LED) tube lamp, comprising:

70. Ivey813's LED-based light tube is mains line powered and thus bypasses a ballast. Ivey813, 2:50-56, 5:33-35; Ivey345, ¶¶[0010], [0004]-[0005]; §VIII.A.5.

(i) Limitation [10a]: a lamp tube;

71. Ivey813's tube includes elongate housing 12. Ivey813, 2:57-60.

(j) Limitation [10b]: two end caps, each having an external connection terminal, and each coupled to a respective end of the lamp tube, wherein the external connection terminals are configured to receive an external driving signal;

72. Ivey813's housing 12 includes two end caps 20 attached at opposing ends. Ivey813, 1:37-39, 1:50-51. Each end cap 20 includes pins 32 ("external connection terminals"), which may electrically connect the tube to fixture 11 and thus receive mains AC power ("external driving signal"). Ivey813, 5:1-16; Ivey345, ¶¶[0010], [0004]-[0005]; §VIII.A.5.

(k) Limitation [10c]: an LED module, configured to emit light based on the external driving signal; and

73. Within Ivey813's housing 12 is circuit board 14, on which LEDs 18 ("LED module") are mounted. Ivey813, 2:13-17, 3:27-37, 3:63-67; Ivey345, ¶¶[0016], [0037]; §VIII.A.5. LEDs 18 produce light and are powered by DC power from power converter 36's rectifier circuit (Ivey345's rectifier 120 (solid-blue)), which rectifies mains AC power:

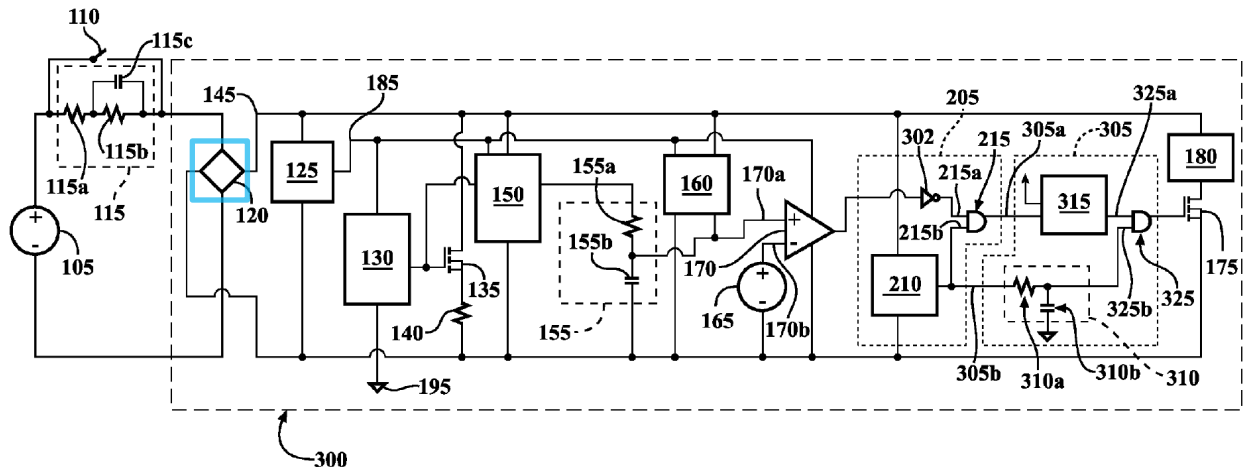


FIG. 3

Ivey345, Fig.3, ¶¶[0015]-[0016], [0037]; Ivey813, 3:23-37, 3:43-47, 5:33-35; §VIII.A.5.

- (l) **Limitation [10d]:** an installation detection module, coupled on a power loop of the LED tube lamp and configured to detect a transient current on the power loop and compare the transient current with a predefined signal,

74. Ivey345's current limiting circuit ("installation detection module") includes various components coupled to the tube's device power rail 145, such as detector 150 and comparator 170 ("coupled on a power loop of the LED tube lamp"). See §§VIII.A.6(b)-VIII.A.6(d). Detector 150 detects, e.g., a current variation across device power rail 145 ("configured to detect a transient current on the power loop") and outputs a representative signal, which comparator 170 compares to a threshold signal ("compare the transient current with a predefined signal"). See §VIII.A.6(e).

- (m) **Limitation [10e]:** wherein when a signal level of the transient current is smaller than the predefined signal, the installation detection module limits a current on

the power loop less than 5 MIU by controlling a conduction state of the power loop.

75. When the representative signal is lower than the threshold signal (“when a signal level of the transient current is smaller than the predefined signal”), the current limiting circuit maintains current flow at a safe level—e.g., <5MIU—by signaling load switch 175 to remain off. See §VIII.A.6(f).

(n) **Claim 11: The LED tube lamp according to claim 10, wherein the installation detection module comprises: a detection determining circuit, configured to detect the transient current, compare the transient current with the predefined signal, and output a high level signal or a low level signal according to a comparison result.**

76. Detector 150, comparator 170, and Z test load 140 altogether form the claimed “detection determining circuit.” Compare Ivey345, Fig.3 (below), with, e.g., ’174 Patent, Fig.15K, 50:3-54.

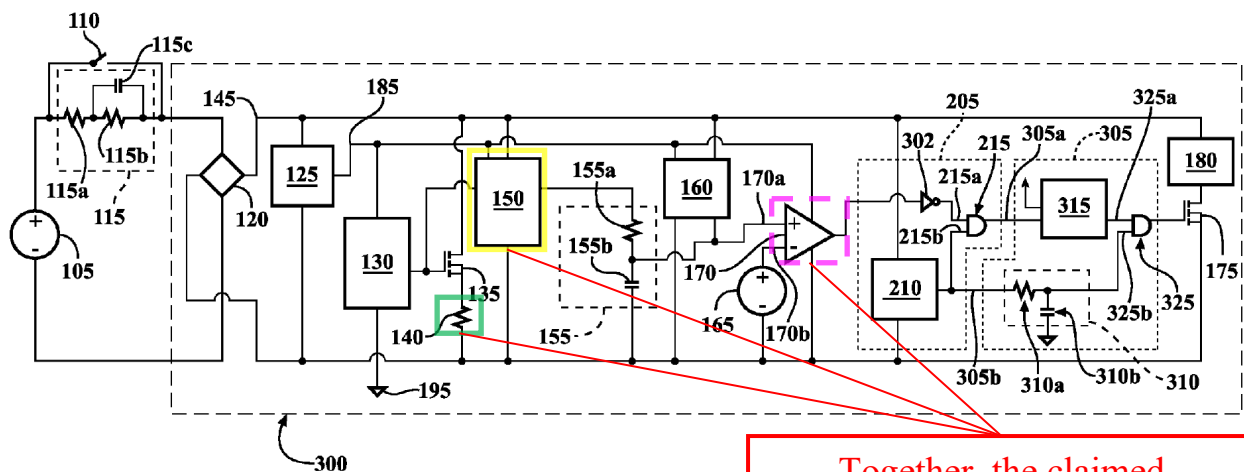


FIG. 3

Together, the claimed “detection determining circuit”

Specifically, detector 150 detects the variation across device power rail 145 (“configured to detect the transient current”) and outputs a representative signal to comparator 170, which compares detector 150’s output signal to the threshold signal (“compare the transient current with the predefined signal”) and outputs either a low or high signal depending on this comparison (“output a high level signal or a low level signal according to a comparison result”). *See* §§VIII.A.6(d)-VIII.A.6(g).

- (o) **Claim 12: The LED tube lamp according to claim 11, wherein the installation detection module further comprises:
a detection pulse generating module, configured to generate a pulse signal, wherein the detection determining circuit detects the transient current on the power loop during a pulse-on period of the pulse signal.**

77. Ivey345’s current limiting circuit includes oscillator 130 (“detection pulse generating module”), which outputs an oscillating clock signal. *See* §VIII.A.6(b). While the clock signal oscillates high, detector 150 detects the variation across the device power rail 145. *See* §VIII.A.6(d).

- (p) **Claim 16: The LED tube lamp according to claim 12, wherein the installation detection module further comprises:
a switch circuit, coupled to the detection determining circuit and the detection pulse generating module and configured to maintain a conductive state during the pulse-on period of the pulse signal or when receiving**

the low level signal from the detection determining circuit.

78. For similar reasons discussed in §VIII.A.6(c), test load switch 135, alone or in combination with load switch 175, meets the claimed “switch circuit.”

79. Specifically, test load switch 135 connects to Z test load 140 and oscillator 130 (“coupled to the detection determining circuit and the detection pulse generating module”). *See* §VIII.A.6(c). Test load switch 135 closes while the clock signal oscillates high (“maintain[s] a conductive state during the pulse-on period of the pulse signal”) and thus, alone, meets the claimed “switch circuit.” *See* §VIII.A.6(c).

80. As a first and second alternative, while test load switch 135 is closed (“during the pulse-on period of the pulse signal”) and a normal configuration is detected via detector 150’s detection of current or voltage variation across device power rail 145, load switch 175 also remains closed (“maintain[s] a conductive state”), allowing current to flow from device power rail 145 through the LEDs. *See* §VIII.A.6(c). By causing load switch 175 to remain closed accordingly, test load switch 135 alone (first alternative) or in combination with load switch 175 (second alternative) meets the claimed “switch circuit.” *See* §VIII.A.6(c).

81. As a third alternative, load switch 175 alone meets the claimed “switch circuit”:

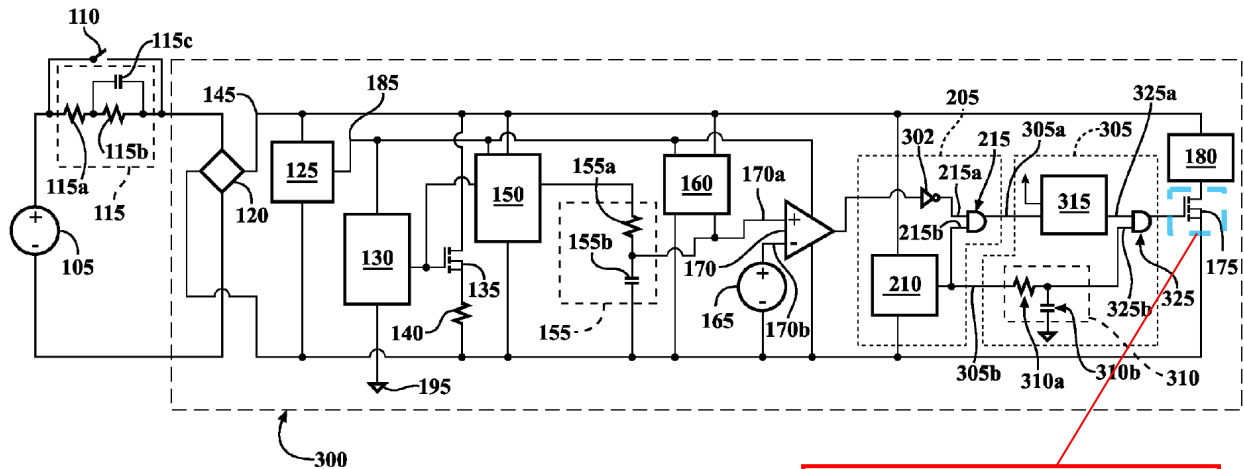


FIG. 3

Claimed “switch circuit”

Ivey345, Fig.3. Specifically, load switch 175’s activation is determined by detector 150’s detection, which is synchronized by oscillator 130’s clock signal (“coupled to the detection determining circuit and the detection pulse generating module”). See §§VIII.A.6(d)-VIII.A.6(g). Thus, while oscillator 130’s clock signal oscillates high (“during the pulse-on period of the pulse signal”) and a normal configuration is detected, load switch 175 remains closed (“maintain a conductive state”). See §§VIII.A.6(d)-VIII.A.6(g).

- (q) **Claim 17: The LED tube lamp according to claim 16, wherein the installation detection module further comprises:**
a detection result latching circuit, coupled to the detection determining circuit, the detection pulse generating module, and the switch circuit, wherein at least one of the pulse signal, the high level signal, and

load switch 135, forms the claimed “switch circuit” (“coupled to... the switch circuit”) (*see* §VIII.A.6(p)).

83. Latch 315 “starts at power-up in the ‘on’ state” and thus initially outputs a high signal to load switch 175 through main load detection logic circuit 325. Ivey345, ¶¶[0045]-[0046]. If the comparator 170’s output signal to logic inverter 302 is likewise high (normal configuration), latch 315’s output to load switch 175 will remain high (“the high level signal... is provided to the switch circuit through the detection result latching circuit”). Ivey345, ¶[0045]. However, if comparator 170’s output signal logic to logic inverter 302 becomes low (fault configuration), latch 315 too will output a low signal to load switch 175, but will also “prevent the activation of the load switch 175... until the device is disconnected and power is reapplied” (“the low level signal is provided to the switch circuit through the detection result latching circuit”). Ivey345, ¶¶[0044]-[0045].

84. Alternatively, should the *Maxlite* Court’s construction of “detection result latching circuit” apply (*see* EX1025, 26-28; §VII.B.1), Ivey345 teaches more specifically that latch 315 receives oscillator 130’s clock signal either directly from oscillator 130 or indirectly via another synchronized device, e.g., detection validation timer 210 (dotted-yellow). Ivey345, ¶¶[0043], [0039]. In other words, Ivey345 teaches that oscillator 130’s clock signal is outputted to each synchronized device either individually using parallel interconnections or serially using “daisy

chaining”—a commonly used circuit design technique for synchronizing devices where a first device (e.g., timer 210) receives the clock signal and outputs the clock signal to a second device (e.g., latch 315), which may do the same to a third device, and so forth to establish a serial daisy chain cascade that synchronizes each connected device. Ivey345, ¶¶[0043], [0039]; *see also, e.g.*, Pyeon, 5:36-56, Fig.2. And as commonly known, daisy chaining provides numerous advantages over parallel interconnections, including “utilizing fewer and shorter interconnections [to] make[] the overall implementation less vulnerable to undesirable effects, such as propagation delay and crosstalk,” thereby “allow[ing] the devices to be operated at higher speeds,” while also “reduc[ing] complexity [to] enable[] a subsystem containing the devices to be implemented in a smaller area thus allowing the subsystem to occupy a smaller footprint.” Pyeon, 2:29-54.

85. To gain such advantages, a POSITA would have recognized that, while oscillator 130’s clock signal could be at least partially daisy chained as disclosed in Ivey345 by connecting oscillator 130 to timer 210 to latch 315 (Ivey345, ¶¶[0039], [0043]), a more preferable configuration would have been to fully daisy chain the devices to be synchronized—e.g., by then also connecting latch 315 to test load switch 135 to detector 150 (*see* Ivey345, ¶¶[0021], [0024], [0039], [0043])—to maximize such benefits. Doing so, latch 315 therefore receives and outputs

oscillator 130's clock signal to test load switch 135.³ And while oscillator 130's clock signal oscillates high or low, this output from latch 315 to test load switch 135 would likewise oscillate high or low, respectively. *See* EX1025, 26-28 (“reverses its signal level when the... ***pulse signal from the detection pulse generating module*** is applied”). At the same time, logic inverter 302 receives comparator 170's output and sends the reverse signal to latch 315 to control whether latch 315 should latch a “high” or “low” output. EX1025, 26-28 (“reverses its signal level when the ***detected result***... is applied and ***maintains its signal level based on the detected result***”); Ivey345, ¶¶[0043]-[0046], [0030]-[0032].

86. As a further alternative, should the claim conjunctively require each of the recited “pulse signal,” “high level signal,” and “low level signal” to be “provided to the switch circuit through the detection result latching circuit” regardless of the *Maxlite* Court's construction, test load switch 135 and load switch 175 would together form the claimed “switch circuit.” *See* §VIII.A.6(p). As explained above, test load switch 135 receives the clock signal through latch 315 via daisy-chaining,

³ Should a mapping of “switch circuit” be required here, test load switch 135 alone or together with load switch 175 would thus form the claimed “switch circuit.” *See* §VIII.A.6(p).

while load switch 175 receives a high/low signal from latch 315 when comparator 170's signal is high/low, respectively.

- (r) **Limitations [23pre]-[23c]: A light-emitting diode (LED) tube lamp, comprising:
a lamp tube;
two end caps, each having an external connection terminal, and each coupled to a respective end of the lamp tube, wherein the external connection terminals are configured to receive an external driving signal;
an LED module, configured to emit light based on the external driving signal; and**

87. *See* §§VIII.A.6(h)-VIII.A.6(k).

- (s) **Limitation [23d]: an installation detection module, coupled to a power loop of the LED tube lamp and configured to detect a sampling signal on the power loop and compare the sampling signal with a predefined signal,**

88. *See* §VIII.A.6(l). The detected variation across device power rail 145 is “a sampling signal on the power loop” as claimed.

- (t) **Limitation [23e]: wherein a leakage loop is formed between the external connection terminal on one of the end caps and a ground when the one of the end caps is inserted into a lamp socket but the other one is grounded by an object, and**

89. Ivey345's current limiting circuit “maintain[s] the current flowing through the subject at a low and safe level” when a fault configuration occurs, such as “if the power terminal is connected using one connector and the subject, for example a person installing a new bulb, comes into contact with the return terminal in another connector that has not yet been mated,... completing the circuit from the

return terminal to ground” (“a leakage loop is formed between the external connection terminal on one of the end caps and a ground when the one of the end caps is inserted into a lamp socket but the other one is grounded by an object”). Ivey345, ¶¶[0010], [0005], [0013]-[0014].

(u) Limitation [23f]: wherein the installation detection module is activated by a driving voltage on the leakage loop.

90. Oscillator 130, detector 150, comparator 170, threshold signal source 165, and other components of Ivey345’s current limiting circuit are powered by “auxiliary power supply 125,” which is directly powered by rectifier 120 over device power rail 145. Ivey345, ¶¶[0016]-[0019], [0024], [0029], [0031]. The current limiting circuit is powered accordingly even when a fault configuration occurs, as in such a situation the current limiting circuit nevertheless receives sufficient power to detect an increased variation across device power rail 145 and to signal load switch 175 to remain off in response, limiting current flow to a safe and low level (“activated by a driving voltage on the leakage loop”). See Ivey345, ¶¶[0025]-[0026], [0010], [0016]-[0018].

(v) Claim 24: The LED tube lamp according to claim 23, wherein each end cap further has a dummy terminal for connecting to the lamp socket, and at least one

dummy terminal is electrically isolated from the installation detection module.

91. Ivey813 states that “[o]ne of the two pins 32 [of end caps 20] can be a ‘dummy pin’ that does not provide an electrical connection” (“each end cap further has a dummy terminal...”). Ivey813, 5:1-7.

(w) Claim 25: The LED tube lamp according to claim 23, wherein the driving voltage is generated based on the external driving signal when the leakage loop is formed.

92. Auxiliary power supply 125 is powered by rectifier 120—and thus Ivey813 fixture 11’s AC power (“the driving voltage is generated based on the external driving signal”)—and powers the various components of the current limiting circuit even when a fault configuration occurs (“when the leakage loop is formed”). *See* Ivey345, ¶¶[0015]-[0019], [0024]-[0026], [0029], [0031], [0010].

**(x) Limitations [26pre]-[26d]: A light-emitting diode (LED) tube lamp, comprising:
a lamp tube;
two end caps, each having an external connection terminal, and each coupled to a respective end of the lamp tube, wherein the external connection terminals are configured to receive an external driving signal;
an LED module, configured to emit light based on the external driving signal; and
an installation detection module, coupled to a power loop of the LED tube lamp and configured to detect a sampling signal on the power loop and compare the sampling signal with a predefined signal,**

93. *See* §§VIII.A.6(r)-VIII.A.6(s).

- (y) **Limitation [26e]:** wherein the installation detection module comprises:
a control module, configured to output a control signal for controlling a conduction state of the power loop and when a signal level of the sampling signal is smaller than the predefined signal, the control module limits a current on the power loop less than 5 MIU by controlling the conduction state,

94. Ivey345's current limiting circuit meets the claimed "control module."

As Ivey345 teaches, the current limiting circuit controls whether current may flow from device power rail 145 through the LEDs by signaling load switch 175 to remain either on or off ("output a control signal for controlling a conduction state of the power loop"). Ivey345, ¶¶[0010], [0044]-[0045]. When detector 150's representative signal is lower than threshold signal source 165's threshold signal, the current limiting circuit maintains current flow at a safe level—e.g., <5MIU—by signaling load switch 175 to remain off. Ivey345, ¶¶[0010], [0023] [0030]-[0032], [0044]-[0045]; §VIII.A.6(f).

- (z) **Limitation [26f]:** wherein the control module generates the control signal having a first waveform during a detection stage and generates the control signal having a second waveform during an operating stage.

95. Ivey345's current limiting circuit includes detection validation timer 210 (dotted-yellow):

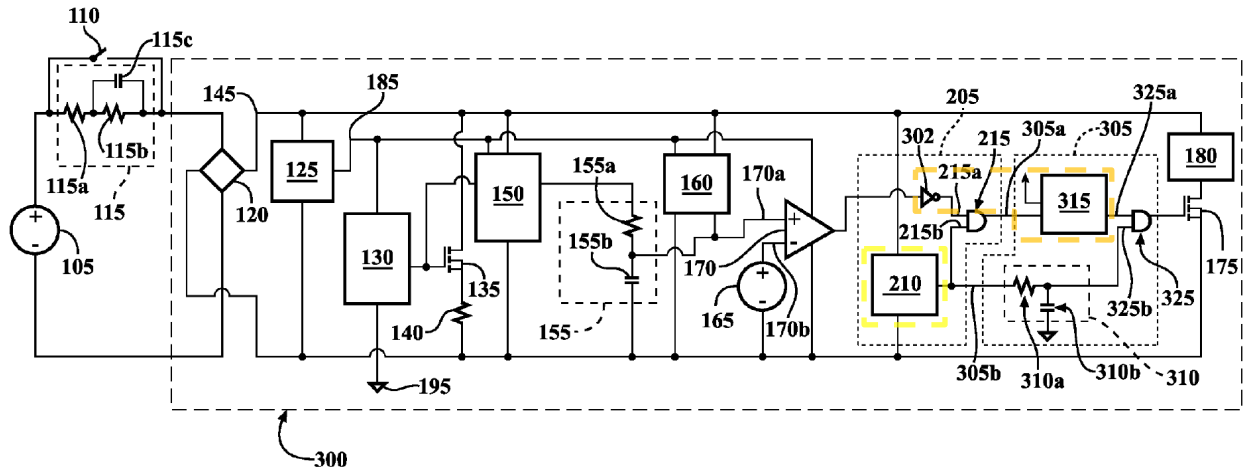


FIG. 3

Ivey345, Fig.3; ¶[0039]. Timer 210 is “a digital counter that outputs a ‘low’ signal initially and outputs a ‘high’ signal after an amount of time has lapsed.” Ivey345, ¶[0039]. Timer 210’s output is received by detection logic circuit 325—an AND gate—which also receives latch 315’s output, thereby ensuring at startup that “no subject is detected in the electrical circuit” for a “detection valid time” before latch 315 is allowed turn on load switch 175. Ivey345, ¶¶[0045], [0038]-[0039]. Thus, while this initial detection is performed for the detection valid time at startup, a low signal is sent to load switch 175 (“generates the control signal having a first waveform during a detection stage”). Ivey345, ¶¶[0044]-[0045], [0038]-[0039]. If a normal configuration is maintained thereafter, latch 315’s high signal will then be permitted to pass through detection logic circuit 325 to load switch 175, allowing the LEDs to receive power from device power rail 145 and thus operate (“generates the control signal having a second waveform during an operating stage”). Ivey345, ¶¶[0044]-[0045], [0038]-[0039], [0010].

- (aa) **Claim 27:** The LED tube lamp according to claim 26, wherein the control module comprises:
a detection result latching circuit, coupled to a detection determining circuit, a detection pulse generating module, a switch circuit, wherein at least one of a pulse signal, a high level signal, and a low level signal is provided to the switch circuit through the detection result latching circuit.

96. See §VIII.A.6(q). For the same reasons that Ivey345's current limiting circuit meets claim 17's "installation detection module," the current limiting circuit meets claim 27's "control module."

- (bb) **Limitations [28pre]-[28c]:** A light-emitting diode (LED) tube lamp, comprising:
a lamp tube;
two end caps, each having an external connection terminal, and each coupled to a respective end of the lamp tube, wherein the external connection terminals are configured to receive an external driving signal;
an LED module, configured to emit light based on the external driving signal; and

97. See §§VIII.A.6(h)-VIII.A.6(k).

- (cc) **Limitation [28d]:** an installation detection module, coupled on a power loop of the LED tube lamp and configured to generate a pulse signal for controlling a conduction state of the power loop and detect a sampling signal on the power loop during a pulse-on time of the pulse signal,

98. See §VIII.A.6(l). Additionally, the clock signal from Ivey345's current limiting circuit's oscillator 130 controls the activation of both test load switch 135 and load switch 175 ("configured to generate a pulse signal for controlling a conduction state of the power loop"). See §VIII.A.6(p). Detector 150 detects the

variation across device power rail 145 while the clock signal oscillates high (“configured to... detect a sampling signal on the power loop during a pulse-on time of the pulse signal”). *See* §VIII.A.6(o).

(dd) Limitation [28e]: wherein the installation detection module limits a current on the power loop to less than 5 MIU by setting the pulse-on time less than or equal to 1 millisecond.

99. Oscillator 130 outputs a clock signal with a frequency “for example at or about 1 KHz,” which equates to a period of 1ms. Ivey345, ¶¶[0019]-[0020]. Given that such a clock signal oscillates every period between high and low, only a fraction of the clock signal’s 1ms period is high (“setting the pulse-on time less than... 1 millisecond”). This clock signal allows the current limiting circuit to detect a variation on device power rail 145 and limit current to standard-compliant levels—e.g., <5MIU (*see* §VIII.A.6(f))—when a fault configuration is detected. Ivey345, ¶¶[0023]-[0024].

(ee) Claim 29: The LED tube lamp according to claim 28, wherein the installation detection module limits a current on the power loop to less than 5 MIU by setting the pulse-on time between 10 microseconds to 1 millisecond.

100. Ivey345 teaches that oscillator 130 may generate a “varying sinusoidal output.” Ivey345, ¶[0019]. As a POSITA would have recognized, such a sinusoidal signal would result in 50% of the period being high and 50% being low—i.e., a 50% duty cycle. *See* Dedic, ¶[0035] (“50% duty cycle... is naturally true of sinusoidal

signals”). Thus, by utilizing the 1ms period sinusoidal output from Ivey345, the high portion of the signal period would last 0.5ms (“setting the pulse-on time between 10 microseconds to 1 millisecond”). *See* Ivey345, ¶¶[0019]-[0020].

- (ff) Limitations [32pre]-[32c]: A light-emitting diode (LED) tube lamp, comprising:**
a lamp tube;
two end caps, each having an external connection terminal, and each coupled to a respective end of the lamp tube, wherein the external connection terminals are configured to receive an external driving signal;
an LED module, configured to emit light based on the external driving signal; and

101. *See* §§VIII.A.6(h)-VIII.A.6(k).

- (gg) Limitation [32d]: an installation detection module, coupled to a power loop of the LED tube lamp and configured to generate a plurality of pulse signals for controlling a conduction state of the power loop and detect a sampling signal on the power loop during a pulse-on time of each of the pulse signals,**

102. *See* §VIII.A.6(cc). By teaching that oscillator 130 outputs “a digital, continuous time output, a varying sinusoidal output, or another type of output” with a specific “oscillation frequency,” Ivey345 thus teaches that oscillator 130 outputs multiple pulses over time (“a plurality of pulse signals”). Ivey345, ¶¶[0019]-[0020]. Indeed, Ivey345 teaches that oscillator 130 may be “a ring oscillator” (Ivey345, ¶[0019]), which is an oscillator that generates “successive periods” of pulses (Mandal, 6-7).

(hh) Limitation [32e]: wherein a time interval between at least two consecutive pulse signals of the pulse signals is designed such that at least one of the two consecutive pulse signals occurs when the external driving signal is at non-zero level.

103. Oscillator 130's output oscillates "for example at or about 1 KHz," while AC mains oscillates at, e.g., "60 Hz." Ivey345, ¶[0020]. Thus, while AC mains oscillates high, which lasts 8.33ms, 8.33 consecutive pulses occur ("a time interval between at least two consecutive pulse signals of the pulse signals is designed such that at least one of the two consecutive pulse signals occurs when the external driving signal is at non-zero level").

B. Ground 2: Ivey813, Ivey345, and Sadwick, and Claims 1, 3-4, 21-28, 30-31, and 35

104. Ground 2 addresses the potential argument that ground 1 fails because Ivey345's test load switch 135 and Z test load 140 are in parallel, not series, with main load 180 (LEDs).

1. Sadwick

105. Sadwick is directed to a "fluorescent lamp replacement" ("FLR") for replacing "[c]onventional fluorescent tubes." Sadwick, ¶¶[0004], [0066], [0001]. The FLR includes "a rectification stage" that "accepts either an AC lines input"—i.e., the FLR is a type B LED light tube that accepts a standard "100 to 300 VAC 50 Hz or 60 Hz AC line input"—"or a ballast output." Sadwick, ¶¶[0066], [0173], [0161]; Premier, 3-4; *see also* Sadwick, ¶[0061] (incorporating by reference

Sadwick454, which discloses an “LED replacement tube” that draws power from either a ballast or “AC mains” (Sadwick454, 4:43-67)). The FLR also includes a “light source” such as one such “made up of LEDs.” Sadwick, ¶¶[0066].

106. Sadwick notes that, “when the fluorescent lamp replacement is being installed, [a] pin can be exposed and, without protection mechanisms, can shock and injure a user contacting the pin and appearing as an abnormal ground through which an electrical current can flow.” Sadwick, ¶¶[0071] (diagram numbering omitted). To address this “fault hazard condition,” Sadwick’s FLR “provid[es] shock hazard protection against inadvertent contact with exposed pin(s).” Sadwick, ¶¶[0082], [0073]. Sadwick’s Figure 14 depicts such “hazard protection circuitry”:

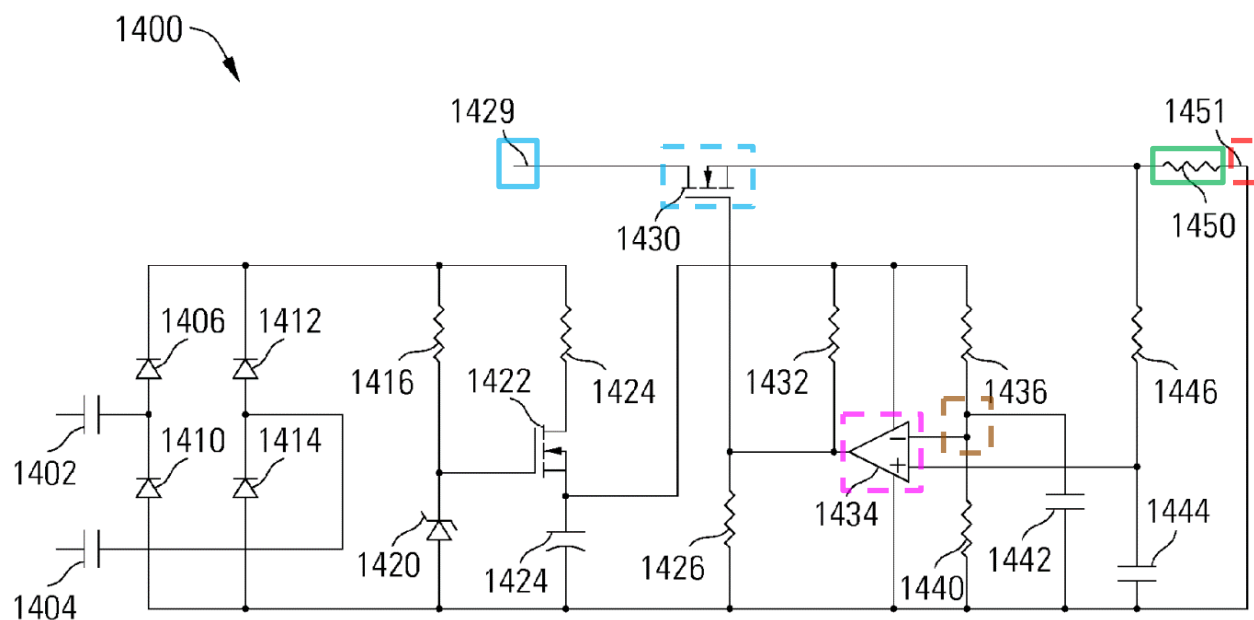


FIG. 14

Sadwick, ¶¶[0080], [0082], Fig.14. As shown, an “input rectification stage of the FLR” is connected to node 1429 (solid-blue). Sadwick, ¶[0080]. The “LED (or OLED or QD) load of the FLR” is connected to node 1451 (dotted-red). Sadwick, ¶[0080]. Between these nodes is transistor/switch 1430”(dotted-blue) and sense resistor 1450 (solid-green), which are thus “in series with” the FLR’s rectifier and LED load. Sadwick, ¶[0080].

107. Sadwick’s hazard protection circuitry detects whether the fault hazard condition above is present by feeding “the voltage across sense resistor 1450” into “the non-inverting input of [a] comparator 1434” (dotted-pink). Sadwick, ¶[0080]. At the same time, “a reference set point” (dotted-brown) “is fed to the inverting terminal of [the] comparator 1434 such that when the signal from the sense resistor 1450 is larger than the reference set point signal, the comparator 1434 goes high and turns on transistor 1430” and thus “current/voltage is allowed to flow to the LED or OLED or QD load.” Sadwick, ¶[0080]. By contrast, “[i]f the current through the sense resistor 14[5]0 produces too small of a voltage then transistor 1430 is turned off preventing current from flowing and thus limiting and preventing a hazard/shock/leakage current condition from occurring.” Sadwick, ¶¶[0080], [0082].

108. Once transistor 1430 is turned off, Sadwick’s hazard protection circuitry “allow[s] for diverse possible responses,” including causing transistor 1430

to be “complete[ly] turn[ed]-off (i.e., latch[ed] off) until power is cycled (i.e., turned off and then turned back on) or, as another example, periodically turned back on for a brief moment to see if the hazard fault condition had cleared (i.e., the FLR had been correctly plugged into the ballast).” Sadwick, ¶[0082].

2. Rationale to Combine the Ivey-UL1993 Combination with Sadwick

109. First, Sadwick evidences that a POSITA would have found modifying the Ivey-UL1993 Combination, specifically such that Ivey345’s Z test load 140 is configured in series with the LEDs to eliminate the need for test load switch 135 and to use load switch 175 instead to periodically permit current to flow from rectifier 120 through the Z test load 140 to be detected by detector 150, to be a modification that amounts to a mere selection between a limited number of known solutions to the same problem.

110. Sadwick, like the Ivey-Sadwick Combination, is directed to a fluorescent-replacing LED-based light tube that may be mains line powered. *Compare* Sadwick, ¶¶[0004], [0173], [0061], *with* Ivey813, 2:11-13, 2:51-56, and §VIII.A.5. Sadwick’s FLR utilizes “hazard protection circuitry” that, like Ivey345’s “current limiting circuit” in the Ivey-UL1993 Combination, protects against the fault configuration also identified in Ivey345—that a user may be electrically shocked during relamping if the user makes contact with an “exposed pin” on one end of the FLR while the other is connected. *Compare* Sadwick, ¶¶[0082], [0071], Fig.8, *with*

Ivey345, ¶¶[0010], [0005], and §VIII.A.5. And Sadwick’s hazard protection circuitry does so by utilizing the same core circuit components configured in a nearly identical layout as Ivey345’s current limiting circuit.

111. Specifically, in both circuits, current periodically flows⁴ from a line-powered LED-based light tube’s rectifier⁵ through a test resistor.⁶ The voltage across the test resistor represents the current exiting the rectifier, which varies depending on whether a fault configuration exists.⁷ To detect such a fault configuration, the test resistor’s voltage is fed into the non-inverting input of a comparator.⁸ At the same time, a reference voltage is fed into the comparator’s

⁴ Compare Sadwick, ¶[0082] with Ivey345, ¶[0021].

⁵ Compare Sadwick, ¶[0080] (“input rectification stage”), with Ivey813, 5:36-39 (“a rectifier circuit”), and Ivey345, ¶¶[0015]-[0016] (“rectifier 120”), and §VIII.A.4.

⁶ Compare Sadwick, ¶[0080] (“sense resistor 1450”), with Ivey345, ¶¶[0023]-[0027] (“Z test load 140”).

⁷ Compare Sadwick, ¶¶[0080], [0082], with Ivey345, ¶¶[0010], [0024]-[0027].

⁸ Compare Sadwick, ¶[0080] (“comparator 1434”), with Ivey345, ¶¶[0024]-[0029] (“comparator 170”), Fig.3.

inverting input.⁹ The comparator then compares the voltages such that when the test resistor's voltage is respectively lower/higher than the reference voltage, a fault configuration is/is not detected by the comparator, which in response outputs a signal to open/close a transistor in series with the LEDs¹⁰ and thus causes current to be below/above a safe level.¹¹ Further, the detection of a fault configuration may also cause this transistor to be latched open until power is cycled.¹²

112. The main difference between the two circuits is the placement of each's test resistor. Specifically, Sadwick's hazard protection circuit configures its test

⁹ Compare Sadwick, ¶¶[0080] (“reference set point signal”), with Ivey345, ¶¶[0030]-[0032] (“detection threshold signal”), Fig.3.

¹⁰ Compare Sadwick, ¶¶[0080], [0082], with Ivey345, ¶¶[0030]-[0032], [0010].

¹¹ Compare Sadwick, ¶¶[0080], [0082] (discussing limiting current to avoid “threat of harm and injury to people”), with Ivey345, ¶¶[0010], [0023], and §VIII.A.5 (discussing limiting current to a safe level, e.g., <5MIU).

¹² Compare Sadwick, ¶[0082] (transistor 1430 may be “complete[ly] turn[ed]-off (i.e., latch[ed] off) until power is cycled (i.e., turned off and then turned back on)”), with Ivey345, ¶[0044] (“[M]ain load shut-off latch 315 will be triggered and produce an output that will prevent both present and future activation of the load switch 175” until “power is removed from the circuit and reapplied”).

resistor (sense resistor 1450) “in series with” the LEDs, thereby allowing a single transistor 1430 (also “in series with” the LEDs) to be used for both (1) permitting current to flow periodically from the rectifier through sense resistor 1450 to determine whether a fault configuration exists, and (2) respectively disabling/maintaining current flow through the LEDs when the fault configuration is/is not detected. Sadwick, ¶¶[0080], [0082]. By contrast, Ivey345’s current limiting circuit in the Ivey-UL1993 Combination configures its test resistor (Z test load 140) in parallel to main load 180 (LEDs), thereby requiring the use of two separate switches for controlling current flow in accordance with the above: (1) test load switch 135 (also parallel to the LEDs) permits current to flow periodically from rectifier 120 through Z test load 140, while (2) load switch 175 (in series with the LEDs) disables/maintains current flow through the LEDs. Ivey345, ¶¶[0021]-[0024], [0010], [0041]-[0045], Fig.3; §VIII.A.5. But the above illustrates the two and only two fundamental configurations that such a test resistor can be placed in relation to the LEDs: series or parallel. Indeed, that circuit components are configured either in series or parallel with one another is a core and known concept in electronics. Physics-Classroom.

113. Accordingly, Sadwick and Ivey345 together identify a limited number of solutions to choose from (i.e., two protection circuit layouts utilizing a test resistor configured either in series or parallel with the LEDs) that solve the same problem in

line-powered LED-based light tubes (i.e., protecting a user from being shocked during relamping when accidentally touching an exposed pin), and a POSITA would have therefore found modifying Ivey345's current limiting circuit in the Ivey-UL1993 Combination to be in accordance with Sadwick's hazard protection circuitry (i.e., configuring Z test load 140 in series with the LEDs and eliminating test load switch 135, as load switch 175 would be used instead for controlling current flow from rectifier 120 through Z test load 140 and the LEDs in accordance with the above) to amount to merely selecting and pursuing one of two such solutions. Sadwick, ¶¶[0080], [0082]; Ivey345, ¶¶[0021]-[0024], [0010], [0035]-[0036], [0045].

114. Second, as explained above, Sadwick's resistor-in-series protection circuit explicitly addresses the same problem addressed in Ivey345—a user accidentally being shocked during relamping (Sadwick, ¶¶[0082], [0071]; Ivey345, ¶¶[0010], [0005])—and a resistor-in-series configuration was therefore a known and suitable technique for addressing that problem. Given the application of Sadwick's resistor-in-series technique to Ivey345's protection circuit was not beyond a POSITA's skill (*see, e.g.*, Sadwick, ¶¶[0080], [0082]), this alone would have motivated a POSITA to combine the Ivey-UL1993 Combination with Sadwick.

115. A POSITA would have also been motivated to combine the Ivey-UL1993 Combination with Sadwick because doing so would have (third) simplified

Ivey345's current limiting circuit and, independently, would have (fourth) improved performance. With respect to simplification, performing the above modification would have allowed various components to be deleted, thereby simplifying the circuit. Even the deletion of a single component at the design phase creates a cascading effect that produces a significant number of downstream benefits, including reduced cost for parts, simpler assembly, reduced die size, improved yield, lower costs for consumers, and increased product long-term reliability due to less parts that could possibly fail. Such benefits are particularly impactful in products such as LED tube lamps that are mass produced in extremely large quantities, and thus provide a strong motivation for modification. And in this instance, a POSITA would have recognized that modifying Ivey345's current limiting circuit in accordance with Sadwick would have allowed a switch to be deleted—specifically test load switch 135—because load switch 175 would have been used instead to control current flow through Z test load 140 and the LEDs as discussed above. *See* Ivey345, ¶¶[0021]-[0024], [0010], [0035]-[0036], [0045]; Sadwick, ¶¶[0080], [0082].

116. And with test load switch 135 deleted, so too could Ivey345's "power-up reset 160." *See* Ivey345, ¶¶[0033]-[0034], Fig.3. Power-up reset 160, "[w]hen power is first applied to the current limiting circuit 100,... turn[s] off main load switch 175... [and] maintains this state until a stable condition is reached and a

determination can be made whether a subject is present in the circuit.” Ivey345, ¶[0034]. In other words, power-up reset 160 ensures that load switch 175 remains off until the signal from detector 150, driven by test load switch 135 (*see* Ivey345, ¶[0024]), permits detection of a human in the circuit (Ivey345, ¶[0034]). But by modifying the Ivey-UL1993 Combination such that one transistor—load switch 175—performs both the load-control and human-detection functions, there would have been no need for power-up reset 160 to control a non-existent additional transistor.

117. Further, the above modification would have also allowed a resistor to be deleted. Specifically, although the above modification would have resulted in Z test load 140—which is simply “a resistor” (Ivey345, Fig.3, ¶[0080])—being configured in series with the LEDs rather than parallel (*see* Sadwick, ¶¶[0080], [0082]), such a modification would not have required placing an additional resistor in series with the LEDs, because a resistor in series with the LEDs would have already existed. As generally known, LEDs must have what is known as a “current limiting resistor” placed in series, because LEDs will otherwise burn out if directly connected to a power source. Parks; Guang, ¶[0011]. Given that such a current limiting resistor would have thus already existed in series with the LEDs in Ivey345’s current limiting circuit, a POSITA would have recognized to use such a preexisting resistor as—and for carrying out the functions of—Z test load 140 when

making the above modification, rather than adding a superfluous resistor in series with the LEDs for serving this same purpose. *see also* Etkina, 3 (demonstrating that current through an LED can be determined by measuring voltage across the LED's current limiting resistor, which has a known resistance); Guang, ¶[0035] (same).

118. Independently, the above modification would have improved performance. Specifically, a POSITA would have recognized that, unlike in the parallel configuration, configuring Z test load 140 in series with the LEDs would have caused the current flowing through Z test load 140 to exactly equal the current flowing from rectifier 120 through the LEDs (which do not always perform as expected due to, e.g., environment and age) and more accurately represent whether a subject is present in the circuit. *See* Briggs, 3:36-44 (“[T]here are uncertainties within the forward voltages of the LEDs, which in turn creates uncertainty with respect to the current level flowing through the LEDs. To manage these uncertainties, the current flowing through the LEDs is measured by determining a voltage level across a known resistor and calculating the current level.”), 3:51-55 (“As shown, the circuit of FIG.1 comprises a plurality of LEDs coupled in series with a channel control transistor and a current sense circuit between a supply voltage V_{DD} and a reference ground.” (diagram numbering omitted)). Such a modification would have thus increased the current limiting circuit's FAULT detection accuracy

and therefore improved performance, motivating a POSITA to perform the modification.

119. So modified, Ivey345’s current limiting circuit in the Ivey-UL1993 Combination (*see* §VIII.A.5) is modified to be in accordance with Sadwick (the “Ivey-UL1993-Sadwick Combination”) such that Z test load 140 is configured “in series with” rectifier 120 and the LEDs (*see* Sadwick, ¶[0080]; Ivey345, ¶¶[0023]-[0024]). Ivey345’s Figure 3, modified below, illustrates the Ivey-UL1993-Sadwick Combination:

Ivey345, Fig.3 (modified). As shown, test load switch 135 is eliminated, as load switch 175 (dotted-blue) instead performs test load switch 135's function of periodically permitting current to flow from rectifier 120 (solid-blue) and device power rail 145 (solid-purple) through Z test load 140 (solid-green), in addition to load switch 175's original function of respectively disabling/maintaining current flow through main load 180 (LEDs) (dotted-red) when a fault configuration is/is not

detected. *See* Sadwick, ¶¶[0080], [0082]; Ivey345, ¶¶[0021]-[0024], [0010], [0035]-[0037], [0045]. As such, the output of oscillator 130 (solid-red) is connected to and controls load switch 175 rather than test load switch 135. *See* Sadwick, ¶¶[0080], [0082]; Ivey345, ¶¶[0021]-[0024], [0010], [0035]-[0036], [0045]. Likewise, power-up reset 160 is also eliminated. *See* Ivey345, ¶¶[0033]-[0034].

120. The current limiting circuit's remaining operations are unchanged. Specifically, detector 150 (solid-yellow) synchronously detects a variation across device power rail 145, and comparator 170 (dotted-pink) compares detector 150's detection result to detector threshold signal source 165's (dotted-brown) signal to detect whether a fault configuration exists. *See* Sadwick, ¶¶[0080], [0082]; Ivey345, ¶¶[0023]-[0032], [0034]-[0035], [0010]. Respectively, if a fault configuration is/is not detected, comparator 170 outputs a "low"/"high" signal to logic inverter 302 and latch 315 (together in dotted-orange), and latch 315 in response outputs a "low"/"high" signal to load switch 175 through main load detection logic circuit 325 to disable/maintain current flow through the LEDs, causing current to be below/above, e.g., 5MIU. *See* Sadwick, ¶¶[0080], [0082]; Ivey345, ¶¶[0034]-[0035], [0010], [0023], [0044]-[0046]; §VIII.A.5. Timer 210 (dotted-yellow) prevents latch 315's signal from passing to load switch 175 until a normal configuration is maintained for a "detection valid time." Ivey345, ¶¶[0045]-[0046], [0030]-[0032].

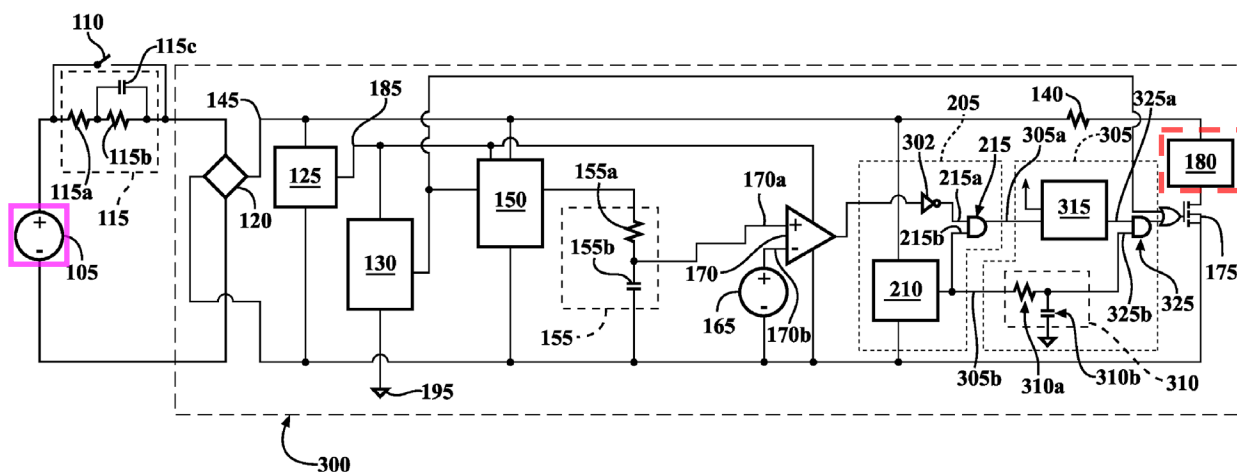
121. Once such time elapses, load switch 175 therefore closes when latch 315's output is high, oscillator 130's output is high, or both, and opens otherwise. Ivey345, ¶¶[0035]-[0036], [0045]-[0046], [0020]-[0022], [0024], [0010]; Sadwick, ¶[0082]. To enable such "or" control of load switch 315, a POSITA would have recognized that the standard practice would have been to place a logical OR gate (dotted-purple) at load switch 175's gate for receiving both latch 315's output and oscillator 130's output.¹³ *See* Nave-1; *see also* Sadwick, ¶[0212] ("In addition, logic, including digital and Boolean logic such as AND, NOT (inverter), OR, Exclusive OR gates, etc. ... can also be used either alone or in combinations including analog and digital combinations for the present invention."); Ivey345, ¶[0046] ("The main load detection logic circuit 325 may be configured to include an AND gate, an NAND gate, a combination of logic gates, or a combination of discrete circuit elements.").

¹³ Should there be an argument that placing this OR gate negates the circuit layout simplification benefits discussed in §VIII.B.2, a POSITA would have recognized that deleting three components from Ivey345's circuit (a switch, resistor, and power-up reset) outweighs adding one component (an OR gate) and results in a net simplification.

4. *Element-by-Element Analysis*

- (a) **Limitation [18pre]:** A detection method for a light-emitting device (LED) tube lamp for preventing a user from electric shock when the LED tube lamp is being installed on a lamp socket, the detection method comprising:

122. The Ivey-UL1993-Sadwick Combination utilizes, within power converter 36 of Ivey813's "LED-based light tube," Ivey345's Sadwick-modified "current limiting circuit," which detects during relamping whether a subject user is making contact with the tube's return terminal while the tube's power terminal is connected to fixture 11 (Ivey345's power source 105 (solid-pink)):



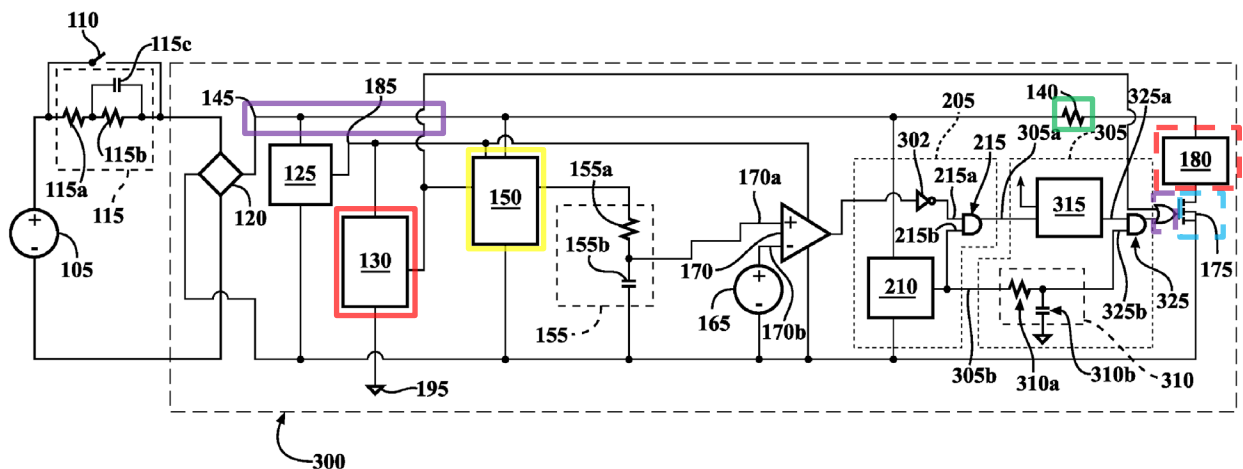
Ivey813, 2:50-54, 5:33-35; Ivey345, Fig.3 (modified), ¶¶[0010], [0004]-[0005]; Sadwick, ¶¶[0080], [0082]; §VIII.B.3. If such is detected during relamping, the current limiting circuit "maintain[s] the current flowing through the subject at a low and safe level," and thus performs the claimed "detection method...." Ivey345, ¶¶[0010], [0004]-[0005]; Sadwick, ¶¶[0080], [0082], [0071].

(b) **Limitation [18a]: generating a pulse signal by a detection pulse generating module;**

123. See §§VIII.A.6(b), VIII.B.3.

(c) **Limitation [18b]: receiving the pulse signal by a switch circuit coupled on a power loop of the LED tube lamp, wherein the switch circuit is conducted during a pulse-on period of the pulse signal to cause the power loop to be conductive;**

124. See §VIII.A.6(c). Differently here, because test load switch 135 is deleted, load switch 175 alone forms the claimed “switch circuit.” §VIII.B.3. The output of oscillator 130 (solid-red) is fed into an OR gate (dotted-purple) at the gate of load switch 175 (dotted-blue), which therefore opens and closes at least while oscillator 130’s clock signal oscillates low and high, respectively:



Ivey345, Fig.3 (modified), ¶¶[0020]-[0022], [0024], [0035]-[0036], [0045]; Sadwick, ¶¶[0080], [0082]; §VIII.B.3.

125. Further, in the Ivey-UL1993-Sadwick Combination, Z test load 140 (solid-green) is instead configured in series with device power rail 145 (solid-purple)

and the LEDs. Ivey345, ¶[0023]; Sadwick, ¶[0080]; §VIII.B.3. Thus, while load switch 175 is closed by oscillator 130's high output accordingly, current flows through Z test load 140 and main load 180 (dotted-red), i.e., the LEDs. Ivey345, ¶¶[0020]-[0024], [0035]-[0036], [0045]; Sadwick, ¶¶[0080], [0082]; §VIII.B.3.

(d) Limitation [18c]: detecting a sampling signal on the power loop;

126. *See* §VIII.A.6(d). Here, although Z test load 140 is configured in series with device power rail 145 and the LEDs, the discussed functions of detector 150 remain unchanged—detector 150 “detect[s] a variation in the current draw or voltage across the device power rail 145” based on current through Z test load 140, and outputs a representative signal used to determine whether a fault configuration exists. Ivey345, ¶¶[0024]-[0026], [0010]; Sadwick, ¶¶[0080], [0082]; §VIII.B.3.

(e) Limitation [18d]: comparing the sampling signal with a predefined signal; and

127. *See* §VIII.A.6(e). Here, the discussed functions of comparator 170 (dotted-pink) and detection threshold signal source 165 (dotted-brown) also remain unchanged—comparator 170 compares detector 150's output signal to a threshold signal from detection threshold signal source 165 (dotted-brown) and produces an output relating to the comparison:

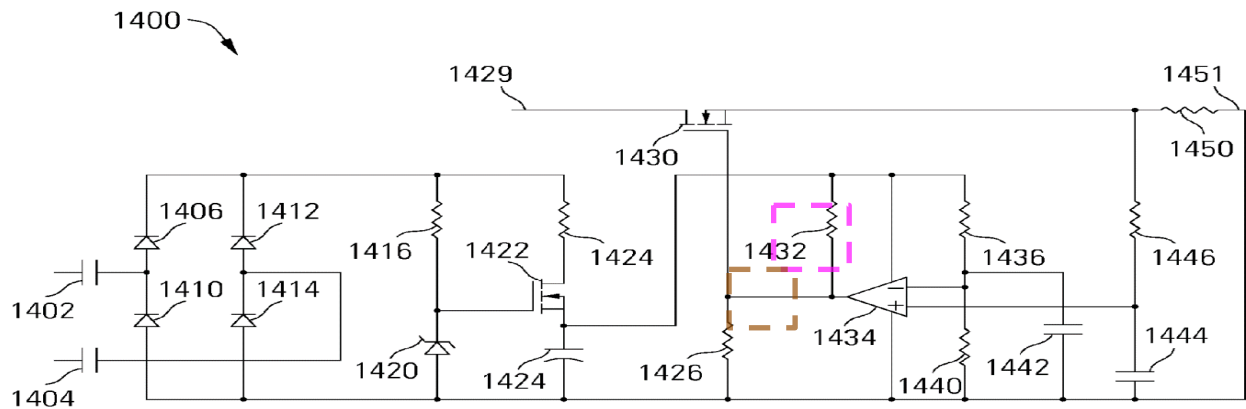


FIG. 14

Ivey345, Fig.3 (modified), ¶¶[0030]-[0032]; Sadwick, ¶¶[0080], [0082]; §VIII.B.3.

- (f) **Limitation [18e]: limiting a current on the power loop less than 5 MIU when a signal level of the sampling signal is smaller than the predefined signal.**

128. Comparator 170's functions in the Ivey-UL1993-Sadwick Combination again remain unchanged—when detector 150's output signal is lower than the threshold signal (fault configuration), comparator 170 outputs a “low” signal that ultimately causes load switch 175 to remain off, causing current to be limited to a safe level, e.g., <5MIU. Ivey345, ¶¶[0010], [0030]-[0032], [0044]-[0045]; Sadwick, ¶¶[0080], [0082]; §§VIII.A.6(f), VIII.B.3.

- (g) **Claim 19: The detection method according to claim 18, further comprising:
conducting the power loop when the signal level of the sampling signal is greater than or equal to the predefined signal.**

129. See §VIII.A.6(g). Here, comparator 170's discussed functions again remain unchanged—when detector 150's output signal is higher than the threshold signal, comparator 170 outputs a “high” signal that ultimately causes load switch

175 to remain closed, allowing current to flow from device power rail 145 through the LEDs. Ivey345, ¶¶[0010], [0030]-[0032], [0041], [0044]-[0045]; Sadwick, ¶¶[0080], [0082]; §VIII.B.3.

- (h) **Limitations [10pre]-[10c]: A ballast by-pass light-emitting diode (LED) tube lamp, comprising:**
 - a lamp tube;**
 - two end caps, each having an external connection terminal, and each coupled to a respective end of the lamp tube, wherein the external connection terminals are configured to receive an external driving signal;**
 - an LED module, configured to emit light based on the external driving signal; and**

130. See §§VIII.A.6(h)-VIII.A.6(k), VIII.B.3.

- (i) **Limitation [10d]: an installation detection module, coupled on a power loop of the LED tube lamp and configured to detect a transient current on the power loop and compare the transient current with a predefined signal,**

131. In addition to Ivey813's tube, the Ivey-UL1993-Sadwick Combination utilizes Ivey345's Sadwick-modified current limiting circuit ("installation detection module"), which includes various components coupled to the tube's device power rail 145 such as detector 150 and comparator 170 ("coupled on a power loop of the LED tube lamp"). See §§VIII.B.4(b)-VIII.B.4(d). The modified current limiting circuit detects a variation across device power rail 145, outputs representative signal, and compares this representative signal to a threshold signal. See §VIII.B.4(e).

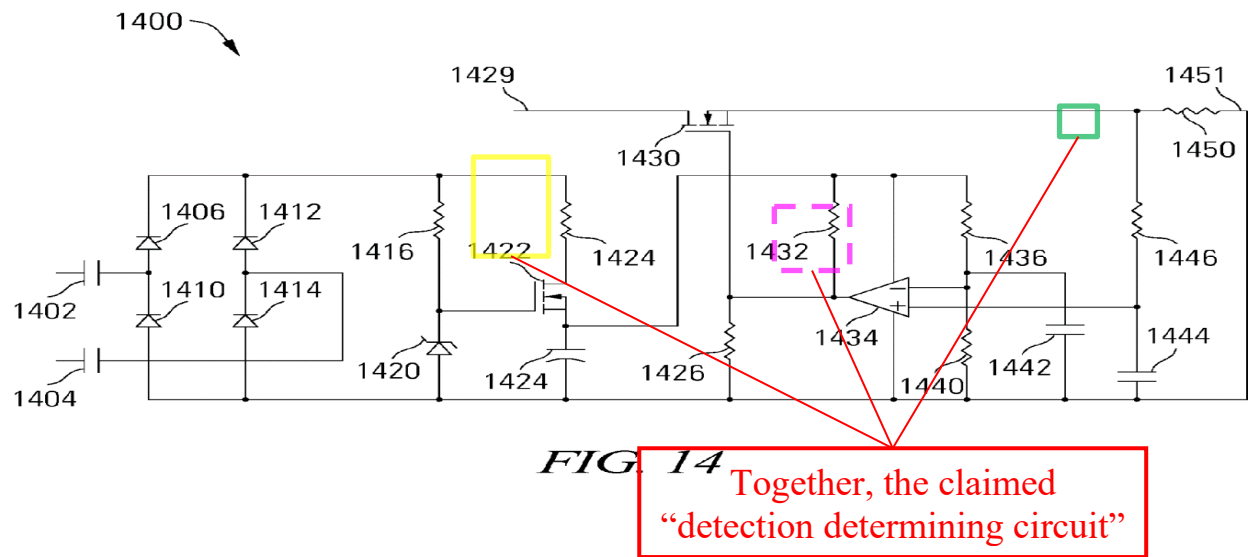
- (j) **Limitation [10e]: wherein when a signal level of the transient current is smaller than the predefined signal,**

the installation detection module limits a current on the power loop less than 5 MIU by controlling a conduction state of the power loop.

132. When the representative signal is lower than the threshold signal, the Ivey-UL1993-Sadwick Combination's current limiting circuit maintains current flow at a safe level—e.g., <5MIU—by signaling load switch 175 to remain off. *See* §VIII.B.4(f).

(k) Claim 11: The LED tube lamp according to claim 10, wherein the installation detection module comprises: a detection determining circuit, configured to detect the transient current, compare the transient current with the predefined signal, and output a high level signal or a low level signal according to a comparison result.

133. As similarly discussed in §VIII.A.6(n), detector 150, comparator 170, and Z test load 140 altogether form the claimed “detection determining circuit.” *Compare* Ivey345, Fig.3 (modified below), *and* Sadwick, Fig.14, ¶¶[0080], [0082], *and* §VIII.B.3, *with, e.g.,* '174 Patent, Fig.15K, 50:3-54.



Detector 150 detects the variation across device power rail 145 and outputs a representative signal to comparator 170, which compares detector 150's output signal to the threshold signal and outputs either a low or high signal depending on this comparison. Ivey345, ¶¶[0024]-[0032], [0010]; Sadwick, ¶¶[0080], [0082]; §§VIII.A.6(n), VIII.B.3.

- (l) **Claim 12:** The LED tube lamp according to claim 11, wherein the installation detection module further comprises:
a detection pulse generating module, configured to generate a pulse signal, wherein the detection determining circuit detects the transient current on the power loop during a pulse-on period of the pulse signal.

See §§VIII.A.6(o), VIII.B.3.

- (m) **Claim 16:** The LED tube lamp according to claim 12, wherein the installation detection module further comprises:
a switch circuit, coupled to the detection determining circuit and the detection pulse generating module and configured to maintain a conductive state during the pulse-on period of the pulse signal or when receiving

the low level signal from the detection determining circuit.

134. *See* §VIII.B.4(c). Load switch 175 is connected to Z test load 140 through the LEDs and receives oscillator 150's clock signal through the OR gate, causing load switch 175 to close at least while the clock signal oscillates high. Ivey345, ¶¶[0020]-[0024], [0035]-[0036], [0045]; Sadwick, ¶¶[0080], [0082]; §VIII.B.3.

- (n) **Claim 17: The LED tube lamp according to claim 16, wherein the installation detection module further comprises:
a detection result latching circuit, coupled to the detection determining circuit, the detection pulse generating module, and the switch circuit, wherein at least one of the pulse signal, the high level signal, and the low level signal is provided to the switch circuit through the detection result latching circuit.**

135. Ivey345's Sadwick-modified current limiting circuit includes "logic inverter 302" and "main load shut-off latch 315" (together in dotted-orange), which together with the OR gate meet the claimed "detection result latching circuit" under both the term's plain and ordinary meaning and the *Maxlite* Court's construction (*see* EX1025, 26-28; §VII.B.1):

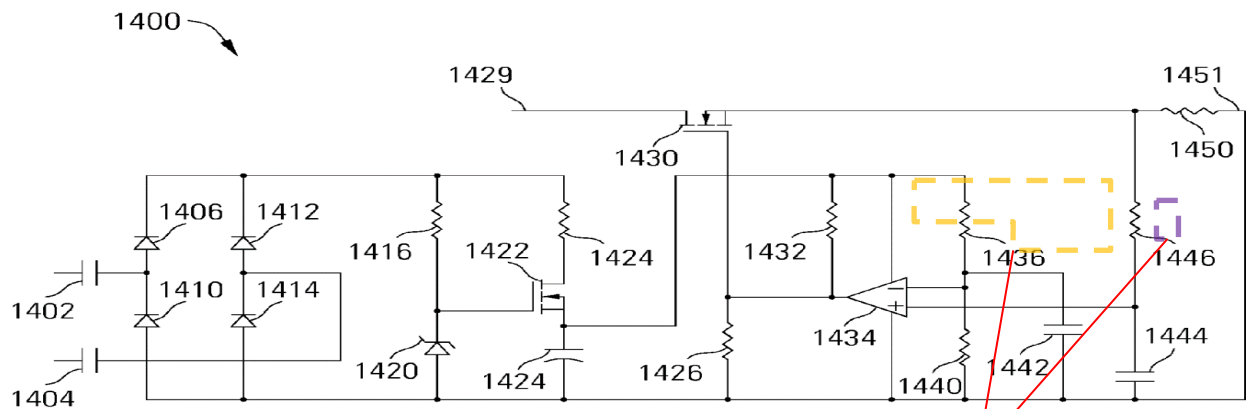


FIG. 14

Together, the claimed “detection result latching circuit”

Ivey345, Fig.3 (modified). Specifically, the OR gate receives oscillator 130’s clock signal, causing load switch 175 to close at least while oscillator 130’s clock signal oscillates high (the recited “coupled to... the detection pulse generating module, and the switch circuit, wherein at least one of... the pulse signal... is provided to the switch circuit through the detection result latching circuit,” and the *Maxlite* Court’s construction of “circuit that reverses its signal level when the... **pulse signal from the detection pulse generating module** is applied”). §VIII.B.3; EX1025, 26-28. The OR gate also receives latch 315’s output, which as explained in §VIII.A.6(q) is latched either “high” or “low” to turn on or off load switch 175, respectively, depending on comparator 170’s output to logic inverter 302 (the recited “coupled to the detection determining circuit,... and the switch circuit, wherein at least one of... the high level signal, and the low level signal is provided to the switch circuit through the detection result latching circuit,” and the *Maxlite* Court’s construction of “circuit

that reverses its signal level when the *detected result...* is applied and *maintains its signal level based on the detected result*'). Ivey345, ¶¶[0043]-[0046], [0030]-[0032]; EX1025, 26-28.

- (o) **Limitations [23pre]-[23d]: A light-emitting diode (LED) tube lamp, comprising:**
 - a lamp tube;**
 - two end caps, each having an external connection terminal, and each coupled to a respective end of the lamp tube, wherein the external connection terminals are configured to receive an external driving signal;**
 - an LED module, configured to emit light based on the external driving signal; and**
 - an installation detection module, coupled to a power loop of the LED tube lamp and configured to detect a sampling signal on the power loop and compare the sampling signal with a predefined signal,**

136. See §§VIII.B.4(h)-VIII.B.4(i).

- (p) **Limitation [23e]: wherein a leakage loop is formed between the external connection terminal on one of the end caps and a ground when the one of the end caps is inserted into a lamp socket but the other one is grounded by an object, and**

137. See §§VIII.A.6(t), VIII.B.3.

- (q) **Limitation [23f]: wherein the installation detection module is activated by a driving voltage on the leakage loop.**

138. See §§VIII.A.6(u), VIII.B.3.

- (r) **Claim 24: The LED tube lamp according to claim 23, wherein each end cap further has a dummy terminal for connecting to the lamp socket, and at least one**

dummy terminal is electrically isolated from the installation detection module.

139. *See* §§VIII.A.6(v), VIII.B.3.

- (s) Claim 25: The LED tube lamp according to claim 23, wherein the driving voltage is generated based on the external driving signal when the leakage loop is formed.**

140. *See* §§VIII.A.6(w), VIII.B.3.

- (t) Limitations [26pre]-[26d]: A light-emitting diode (LED) tube lamp, comprising:
a lamp tube;
two end caps, each having an external connection terminal, and each coupled to a respective end of the lamp tube, wherein the external connection terminals are configured to receive an external driving signal;
an LED module, configured to emit light based on the external driving signal; and
an installation detection module, coupled to a power loop of the LED tube lamp and configured to detect a sampling signal on the power loop and compare the sampling signal with a predefined signal,**

141. *See* §§VIII.B.4(h)-VIII.B.4(i).

- (u) Limitation [26e]: wherein the installation detection module comprises:
a control module, configured to output a control signal for controlling a conduction state of the power loop and when a signal level of the sampling signal is smaller than the predefined signal, the control module limits a current on the power loop less than 5 MIU by controlling the conduction state,**

142. Ivey345's Sadwick-modified current limiting circuit meets the claimed "control module." The modified current limiting circuit controls whether current

may flow from device power rail 145 through the LEDs by outputting a signal from the OR gate to either turn on or off load switch 175. Ivey345, ¶¶[0010], [0044]-[0045]; Sadwick, ¶¶[0080], [0082]; §VIII.B.3. When detector 150's representative signal is lower than threshold signal source 165's threshold signal, the modified current limiting circuit maintains current flow at a safe level—e.g., <5MIU—by signaling load switch 175 to remain off. Ivey345, ¶¶[0010], [0030]-[0032], [0044]-[0045]; Sadwick, ¶¶[0071], [0080], [0082]; §§VIII.B.3, VIII.B.4(f).

- (v) **Limitation [26f]:** wherein the control module generates the control signal having a first waveform during a detection stage and generates the control signal having a second waveform during an operating stage.

143. See §VIII.A.6(z). Here, the discussed functions of timer 210 (dotted-yellow) also remain unchanged—timer 210 prevents latch 315's signal from passing to load switch 175 until a normal configuration is maintained for a detection valid time:

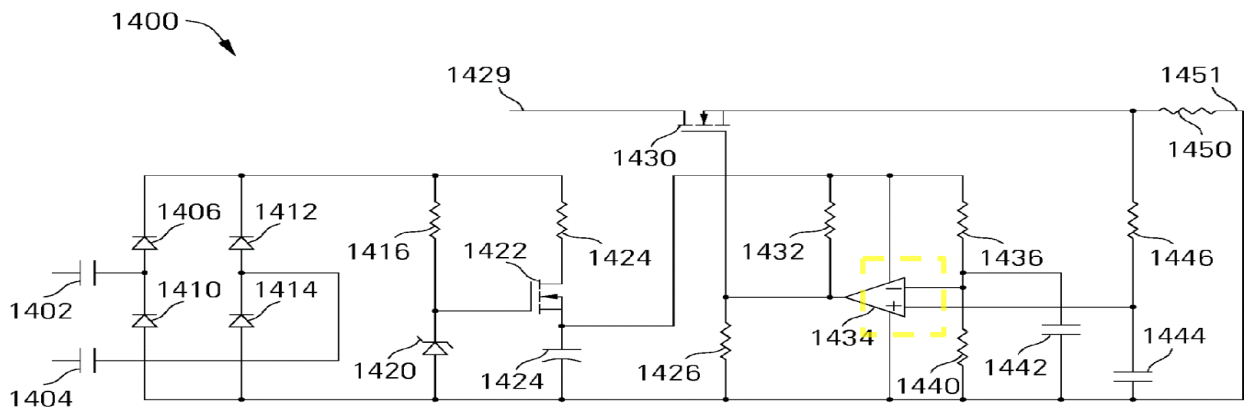


FIG. 14

Ivey345, Fig.3 (modified), ¶¶[0045]-[0046], [0038]-[0039]; §VIII.B.3. Thus, while this initial detection is performed for the detection valid time at startup, a low signal is sent from “detection logic circuit 325” to the OR gate at load switch 175’s gate. *See* Ivey345, ¶¶[0044]-[0045], [0038]-[0039]; §VIII.B.3. At the same time, oscillator 130’s clock signal is also sent to the OR gate, causing the output to load switch 175 to follow the clock signal (“generates the control signal having a first waveform during a detection stage”). *See* Sadwick, ¶¶[0080], [0082]; Ivey345, ¶¶[0021]-[0024], [0010], [0035]-[0036], [0045]; §VIII.B.3. If a normal configuration is maintained thereafter, latch 315’s signal, which is high at startup, will remain high and will also be permitted to pass through detection logic circuit 325 to the OR gate and thus load switch 175, allowing the LEDs to receive constant power from device power rail 145 and thus operate (“generates the control signal having a second waveform during an operating stage”). Ivey345, ¶¶[0044]-[0046], [0038]-[0039], [0010]; Sadwick, ¶[0082]; §VIII.B.3.

- (w) **Claim 27: The LED tube lamp according to claim 26, wherein the control module comprises:
a detection result latching circuit, coupled to a detection determining circuit, a detection pulse generating module, a switch circuit, wherein at least one of a pulse signal, a high level signal, and a low level**

signal is provided to the switch circuit through the detection result latching circuit.

144. *See* §VIII.B.4(n). For the same reasons that Ivey345's Sadwick-modified current limiting circuit meets claim 17's "installation detection module," the modified current limiting circuit meets claim 27's "control module."

- (x) Limitations [28pre]-[28c]: A light-emitting diode (LED) tube lamp, comprising:
a lamp tube;
two end caps, each having an external connection terminal, and each coupled to a respective end of the lamp tube, wherein the external connection terminals are configured to receive an external driving signal;
an LED module, configured to emit light based on the external driving signal; and**

145. *See* §VIII.B.4(h).

- (y) Limitation [28d]: an installation detection module, coupled on a power loop of the LED tube lamp and configured to generate a pulse signal for controlling a conduction state of the power loop and detect a sampling signal on the power loop during a pulse-on time of the pulse signal,**

146. *See* §VIII.B.4(i). Additionally, the clock signal from the modified current limiting circuit's oscillator 130 controls the activation of load switch 175. *See* §VIII.B.4(m). Detector 150 detects the variation across device power rail 145 while the clock signal oscillates high. *See* §VIII.B.4(l).

- (z) Limitation [28e]: wherein the installation detection module limits a current on the power loop to less than**

5 MIU by setting the pulse-on time less than or equal to 1 millisecond.

147. Oscillator 130 outputs an oscillating clock signal with a 1ms period. Ivey345, ¶¶[0019]-[0020]. Thus, only a fraction of the clock signal's 1ms period is high. This clock signal allows variation to be detected on device power rail 145 and current to be limited—e.g., <5MIU (*see* §VIII.B.4(f))—when a fault configuration is detected. Ivey345, ¶¶[0023]-[0024]; Sadwick, ¶¶[0071], [0080], [0082]; §VIII.B.3.

(aa) Claim 29: The LED tube lamp according to claim 28, wherein the installation detection module limits a current on the power loop to less than 5 MIU by setting the pulse-on time between 10 microseconds to 1 millisecond.

148. *See* §§VIII.B.4(z), VIII.A.6(ee).

**(bb) Limitations [32pre]-[32c]: A light-emitting diode (LED) tube lamp, comprising:
a lamp tube;
two end caps, each having an external connection terminal, and each coupled to a respective end of the lamp tube, wherein the external connection terminals are configured to receive an external driving signal;
an LED module, configured to emit light based on the external driving signal; and**

149. *See* §VIII.B.4(h).

(cc) Limitation [32d]: an installation detection module, coupled to a power loop of the LED tube lamp and configured to generate a plurality of pulse signals for controlling a conduction state of the power loop and

detect a sampling signal on the power loop during a pulse-on time of each of the pulse signals,

150. See §§VIII.B.4(y), VIII.B.3.

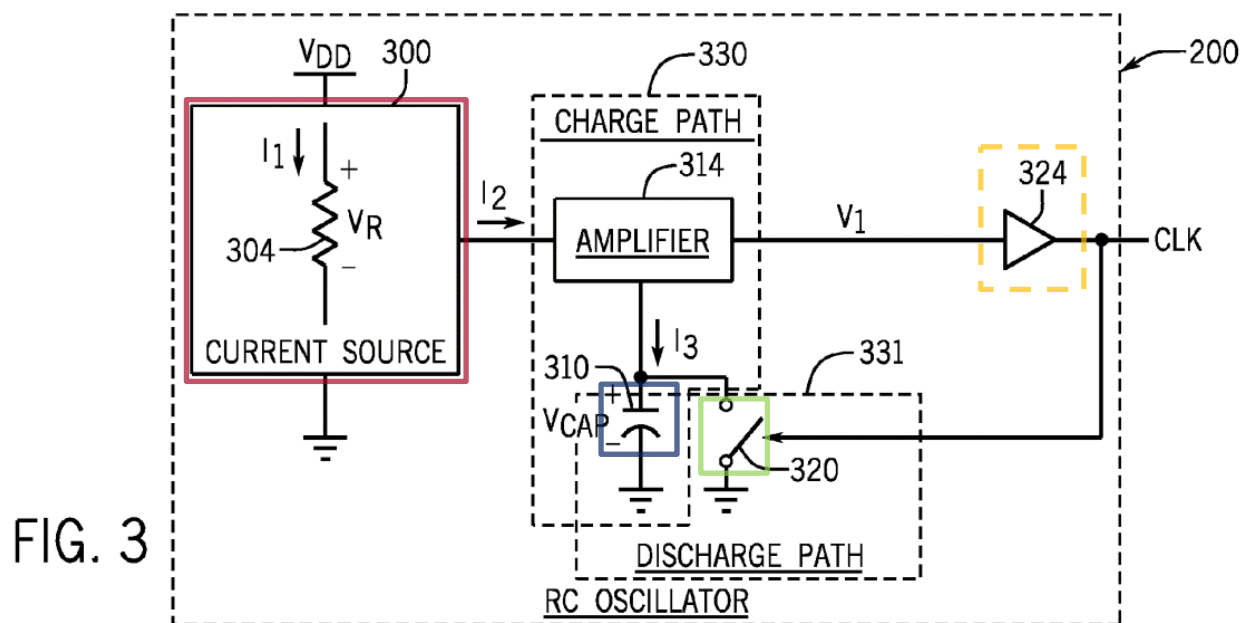
(dd) **Limitation [32e]:** wherein a time interval between at least two consecutive pulse signals of the pulse signals is designed such that at least one of the two consecutive pulse signals occurs when the external driving signal is at non-zero level.

151. See §§VIII.A.6(hh), VIII.B.3.

C. Grounds 3-4: Ivey813, Ivey345, and Powell—and Optionally Sadwick—and Claims 1, 4-5, and 32

1. Powell

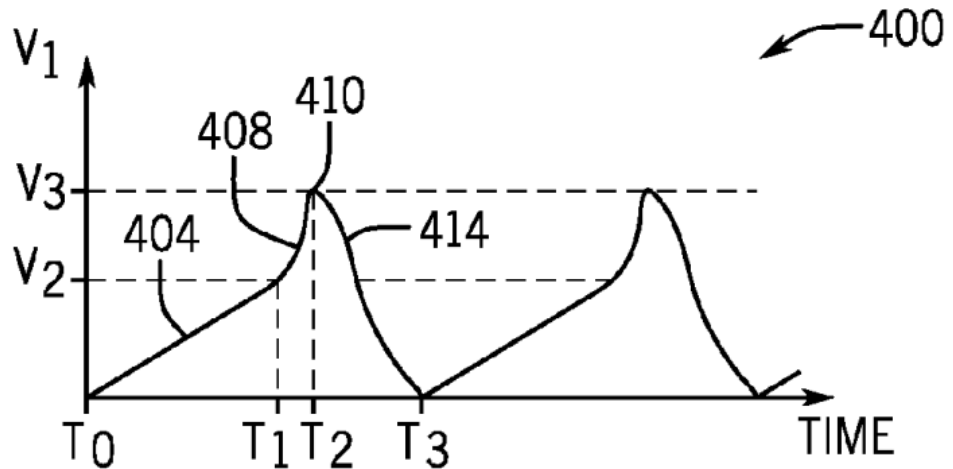
152. Powell is directed to “using a current source to provide a charging current to a capacitor of a resistor-capacitor (RC) tank of an RC oscillator.” Powell, 1:18-22. Powell’s Figure 3 provides an example of such an RC oscillator 200:



Powell, Fig.3. As shown, the RC oscillator is powered by a standard “ V_{DD} supply voltage” and includes current source 300 (solid-dark-red). Powell, 7:23-35, 4:62-64. During a “charging part” of the RC oscillator’s “oscillation cycle,” current source 300 outputs constant current I_2 , which produces charging current I_3 within charge path 330. Powell, 5:1-6. Further, “switch 320 [(solid-light-green)] does not conduct,” causing capacitor 310 (solid-dark-blue) to charge and thus its voltage V_{CAP} to increase. Powell, 5:9-12, 5:23-29. V_{CAP} is amplified by amplifier 314 to produce a voltage V_1 , which is received by “digital buffer 324 [(dotted-orange)] that pulse shapes the V_1 voltage (i.e., sharpens the rising and falling edges of the V_1 voltage) to provide the CLK signal at the output of the buffer 324.” Powell, 5:13-22, 6:1-5.

153. As capacitor 310 charges, “the V_1 voltage eventually reaches a voltage, which causes the switch 320 to conduct, or turn on, and consequently begin [a] discharging part of the cycle in which the capacitor 310 is discharged through the switch [320] to ground.” Powell, 5:29-34. Switch 320 thus forms discharge path 331. Powell, 5:23-25. “The discharging of the capacitor 310, in turn, causes the V_1 and V_{CAP} voltages to decrease; and the lowered V_1 voltage causes the switch 320 to turn off, thereby ending the [dis]charging part of the current cycle and beginning the charging part of the next cycle.” Powell, 5:34-39. Powell’s Figure 4 illustrates V_1 ’s oscillating waveform from charging (T_0 to T_2) and discharging (T_2 to T_3) capacitor 310:

FIG. 4



Powell, Fig.4, 6:34-38.

154. Lastly, current source 300 includes resistor 304, which together with capacitor 310 forms the RC oscillator's "RC tank" that "establishes the resonance frequency for the oscillator"—i.e., "the product of the resistance of the resistor 304 and the capacitance of the capacitor 310 establishes the periodic frequency of the oscillation cycle." Powell, 4:62-64, 2:34-40. "Resistor 304 also establish[es] the current that is provided by the current source [300]." Powell, 2:53-58. Configuring resistor 304 to perform such "dual functions" allows "die area [to be] preserved (i.e., one less resistor is used)," and "current (and therefore power consumption) may be reduced...." Powell, 2:53-58, 6:19-24.

2. *Rationale to Combine the Ivey-UL1993 and Ivey-UL1993-Sadwick Combinations with Powell*

155. Regarding Ivey345's current limiting circuit in the Ivey-UL1993 (*see* §VIII.A.5) and Ivey-UL1993-Sadwick (*see* §VIII.B.3) Combinations, Ivey345 states that oscillator 130 may be, e.g., a "relaxation-type oscillator"; is auxiliary-

powered by, e.g., standard 5V power; and outputs an oscillating signal (*see* Ivey345, ¶¶[0019]-[0020], [0017]). But Ivey345 provides no specific layout for oscillator 130 (solid-red), instead specifying it as an empty box:

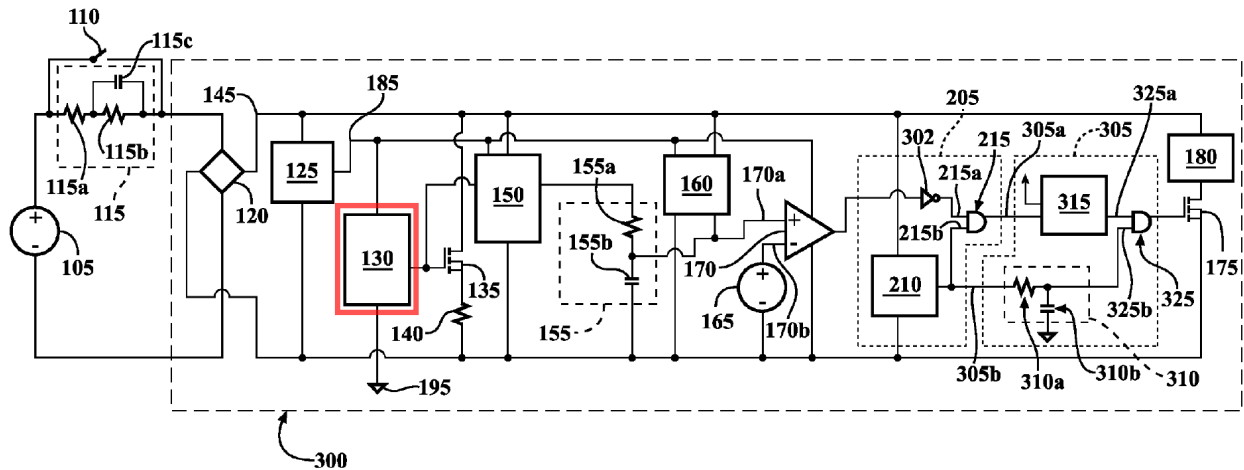


FIG. 3

Ivey345, Fig.3. Such a generic description for oscillator 130 thus teaches no more than using any known oscillator capable of performing oscillator 130’s functions of outputting an oscillating signal that opens and closes test load switch 135 and, indirectly, load switch 175 in the Ivey-UL1993 Combination (*see* §§VIII.A.5, VIII.A.6(c); Ivey345, ¶¶[0020]-[0022], [0024]), or simply load switch 175 in the Ivey-UL1993-Sadwick Combination (*see* §VIII.B.3; Ivey345, ¶¶[0010], [0035]-[0036], [0045]; Sadwick, ¶[0082]).

156. Powell’s RC oscillator is such a known oscillator, as it is a “relaxation-type oscillator” as listed in Ivey345 (i.e., its output depends on charging and discharging a capacitor) (Powell, 4:65-67; *see also* Nave-2); is powered by a standard V_{DD} supply voltage (Powell, 7:23-35); and generates an oscillating signal

V_1 (Powell, 4:65-5:39, 6:34-38, Fig.4). Thus, Ivey345 teaches using an RC oscillator like Powell's as Ivey345's oscillator 130 within the Ivey-UL1993 and Ivey-UL1993-Sadwick Combinations. Further, a POSITA would have been otherwise motivated to use Powell's RC oscillator accordingly, because Powell's RC oscillator likewise generates an oscillating clock signal while providing numerous advantages, including reduced die area and power consumption. Powell, 6:19-21.

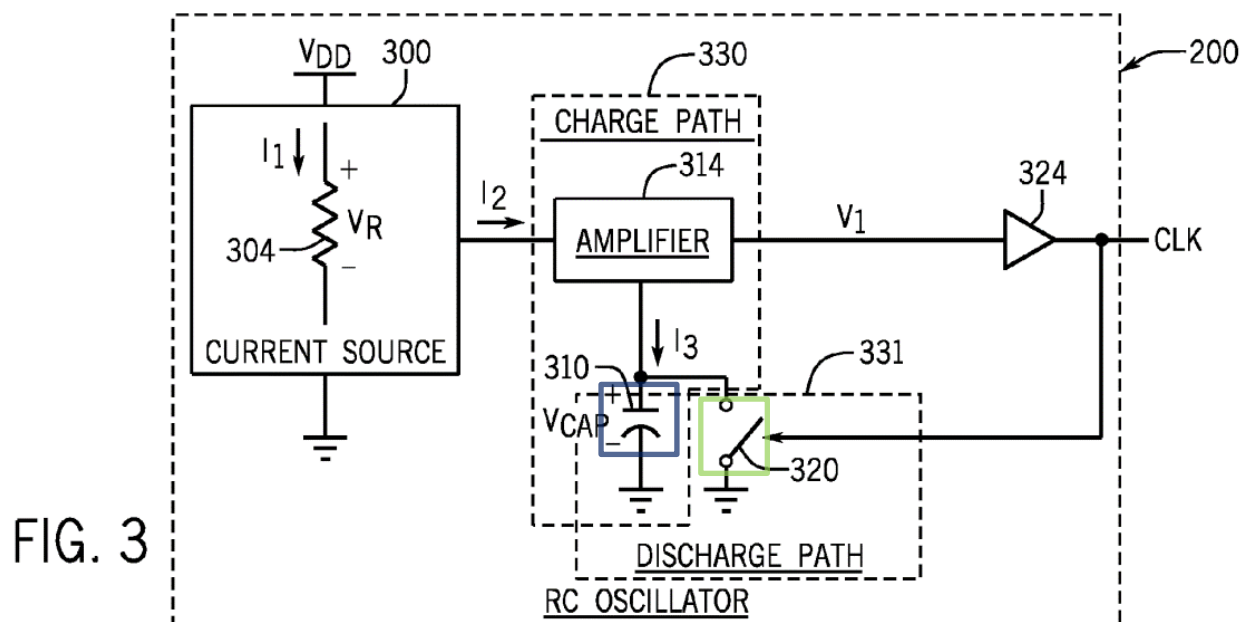
3. The Resulting “Ivey-UL1993-Powell” and “Ivey-UL1993-Sadwick-Powell Combinations”

157. So modified, Powell's RC oscillator is used as oscillator 130 in Ivey345's current limiting circuit within the Ivey-UL1993 Combination (*see* §VIII.A.5; Ivey345, ¶¶[0020]-[0022], [0024]) (the “Ivey-UL1993-Powell Combination”) and the Ivey-UL1993-Sadwick Combination (*see* §VIII.B.3; Ivey345, ¶¶[0010], [0035]-[0036], [0045]; Sadwick, ¶[0082]) (the “Ivey-UL1993-Sadwick-Powell Combination”). Specifically, Powell's RC oscillator is auxiliary-powered—it receives its “ V_{DD} supply voltage” from Ivey345's “auxiliary power supply 125” (*see* Powell, 7:23-35; Ivey345, ¶¶[0016], [0019])—and outputs an oscillating signal (pulse-shaped V_1) to control the same circuit elements as oscillator 130 (Ivey345, ¶¶[0019]-[0022], [0024], [0027], [0043]; Powell, 4:65-5:39, 6:34-38, Fig.4).

4. *Element-by-Element Analysis*

- (a) **Limitation [20a]:** The detection method according to claim 18, wherein the detection pulse generating module comprises a discharge path, and the step of generating the pulse signal by the detection pulse generating module comprises:

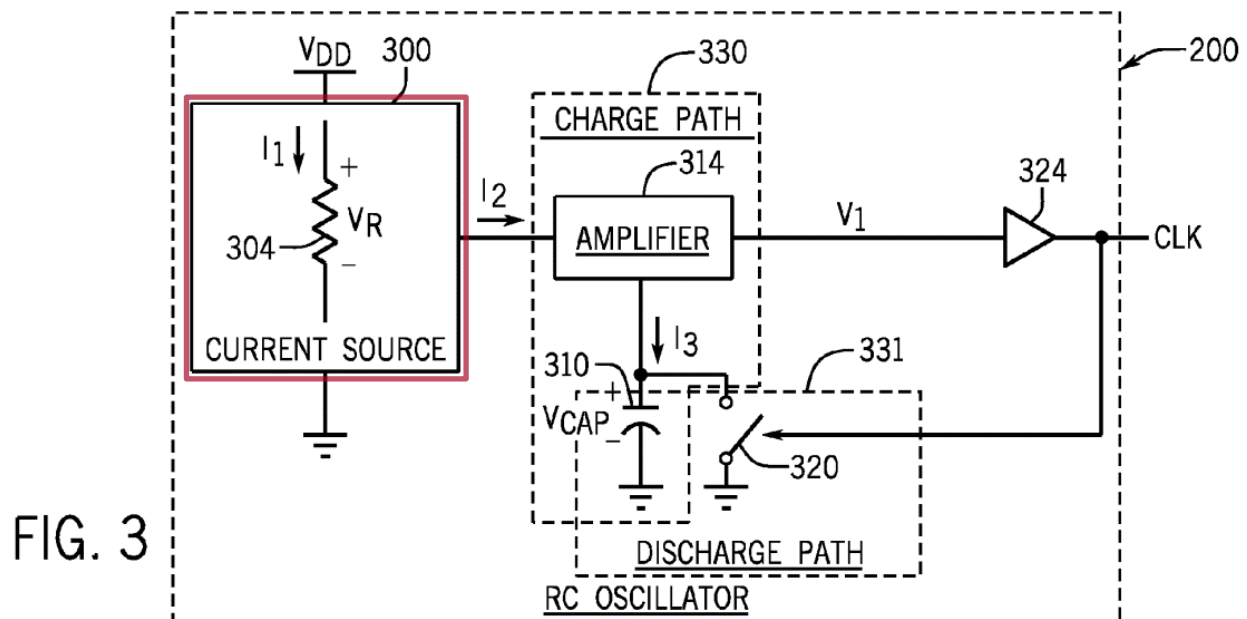
158. In the Ivey-UL1993-Powell and Ivey-UL1993-Sadwick-Powell Combinations, Powell's RC oscillator is used as oscillator 130, which likewise generates an oscillating signal V_1 ("generating the pulse signal by the detection pulse generating module"). Powell, 4:65-5:39, 6:34-38, Fig.4; Ivey345, ¶[0019]; Sadwick, ¶[0082]; §VIII.C.3.



Within Powell's RC oscillator (detection pulse generating module"), switch 320 (solid-light-green) forms discharge path 331 for capacitor 310 (solid-dark-blue), over which charge built up in capacitor 310 is periodically discharged ("discharge path"). Powell, 5:23-39, 4:65-67, Fig.3.

- (b) **Limitation [20b]: pulling the pulse signal to a high level voltage when the detection pulse generating module receives a driving signal;**

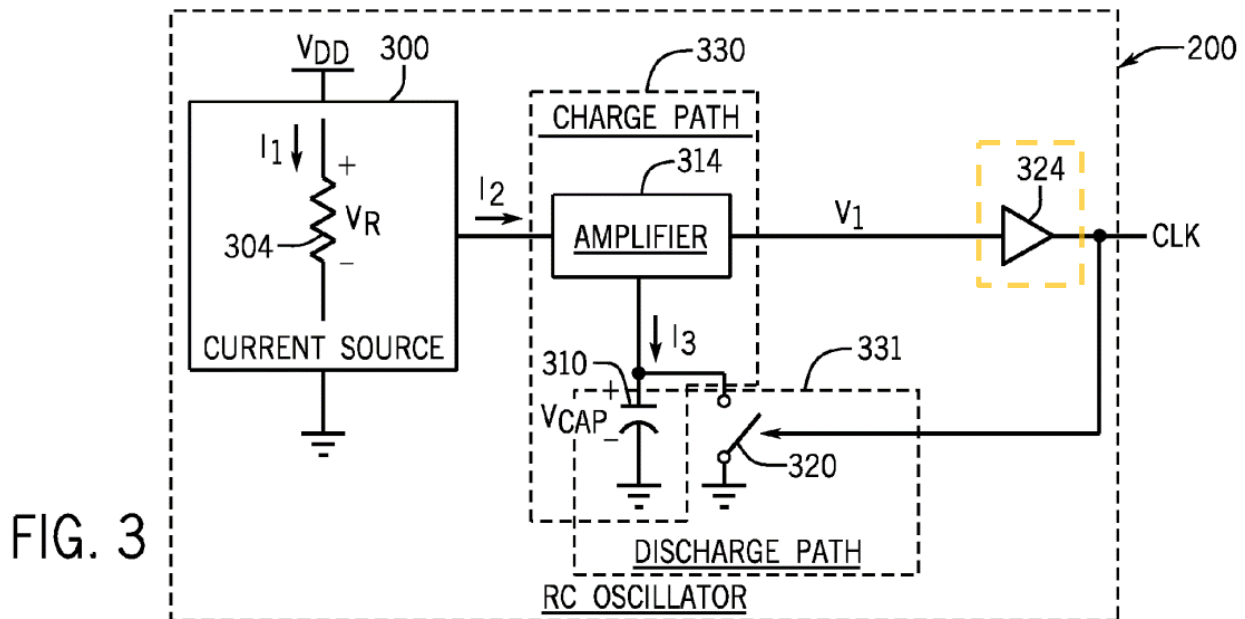
159. To generate the oscillating signal V_1 , current source 300 (solid-dark-red), which is powered by V_{DD} supply voltage (and thus from auxiliary power supply 125 of Ivey345's current limiting circuit) ("receives a driving signal"), "provides a relatively fixed, or constant, current" that charges capacitor 310 during a "charging part" of the RC oscillator's "oscillation cycle":



Powell, Fig.3, 5:1-6. Accordingly, capacitor 310's voltage V_{CAP} increases. Powell, 5:9-12, 5:23-29. V_{CAP} is amplified by amplifier 314 to produce the oscillating signal V_1 , which thus also rises during the charging part of the cycle until reaching a high logic level ("pulling the pulse signal to a high level voltage"), at which point the charging part ends. Powell, 5:13-22, 5:25-34.

- (c) **Limitation [20c]: feeding the pulse signal back to the discharge path, so as to conduct the discharge path when the pulse signal is pulled to the high level voltage; and**

160. V_1 is pulse shaped by buffer 324 (dotted-orange) and then outputted to switch 320 (“feeding the pulse signal back to the discharge path”)¹⁴:



¹⁴ Should there be any argument that the pulse-shaped V_1 signal outputted from buffer 324 is no longer the claimed “pulse signal” because it is modified—and thus different—from the inputted V_1 , such would be inconsistent with PO’s infringement contentions, which argue that one signal (“S5”) that enters a “buffer circuit” (“S4 driver”) and another (“S4”) that exits are both the claimed “pulse signal.” See EX1028, 55-59; EX1029, 55-60.

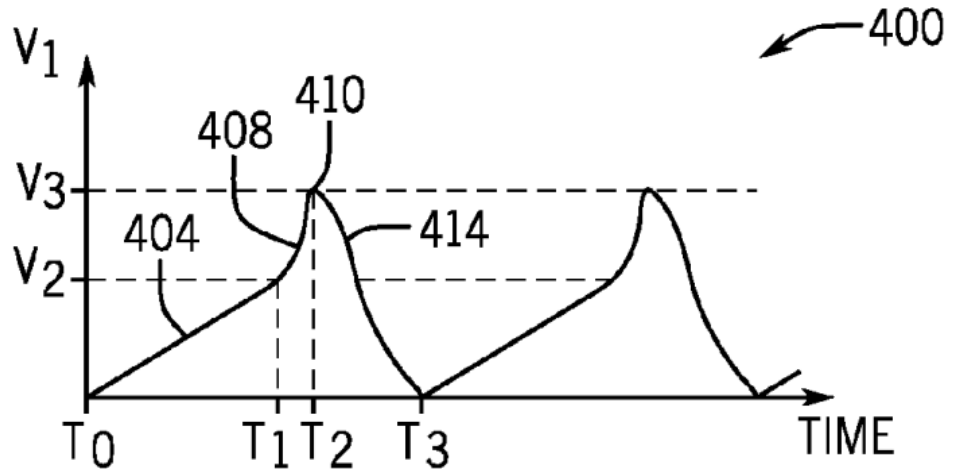
Powell, Fig.3, 5:13-39, 6:1-5. Once V_1 reaches a high logic level (“when the pulse signal is pulled to the high level voltage”), the pulse-shaped V_1 thereafter “causes the switch 320 to conduct, or turn on, and consequently begin the discharging part of the cycle in which the capacitor 310 is discharged through the switch to ground” (“so as to conduct the discharge path”). Powell, 5:29-39.

(d) Limitation [20d]: pulling the pulse signal to a low level voltage after the discharge path has been conducted for a predetermined time period.

161. The discharging of capacitor 310 “causes the V_1 and V_{CAP} voltages to decrease,” eventually reaching a low logic level that “causes the switch 320 to turn off, thereby ending the [dis]charging part of the current cycle and beginning the charging part of the next cycle” (“pulling the pulse signal to a low level voltage after the discharge path has been conducted”). Powell, 5:29-39.

162. Powell’s Figure 4 illustrates V_1 ’s oscillating waveform before pulse-shaping, where the discharging part occurs from T_2 to T_3 (“for a predetermined time period”), while the charging part occurs from T_0 to T_2 :

FIG. 4



Powell, Fig.4, 6:34-38; *see also* Powell, 6:9-12 (“[T]he propagation delay of the digital buffer 324 sets the duration of the discharge part of the oscillation cycle.”).

- (e) **Claim 21: The detection method according to claim 20, wherein the predetermined time period is the same as the pulse-on period of the pulse signal.**

163. From T_2 to T_3 in Powell’s Figure 4, switch 320 is turned on by the pulse-shaped V_1 signal, which is therefore at a high logic level from T_2 to T_3 (“the predetermined time period is the same as the pulse-on period of the pulse signal”).

See Powell, Fig.4, 6:34-38, 5:25-39.

- (f) **Claim 22: The detection method according to claim 20, wherein the step of generating the pulse signal by the detection pulse generating module further comprises: cutting off the discharge path when the pulse signal is pulled to the low level voltage.**

164. When V_1 reaches a low logic level at the end of the discharging part of the oscillation cycle, “the lowered V_1 voltage causes the switch 320 to turn off...”

(“cutting off the discharge path when the pulse signal is pulled to the low level voltage”). Powell, 5:29-39.

(g) Limitation [1pre]: A light-emitting diode (LED) tube lamp, comprising:

165. The Ivey-UL1993-Powell and Ivey-UL1993-Sadwick-Powell Combinations utilize, within power converter 36 of Ivey813’s mains line powered “LED-based light tube,” Ivey345’s “current limiting circuit” as modified in accordance with Powell and, in the latter combination, Sadwick. Ivey813, 2:50-56, 5:33-35; Ivey345, ¶[0010]; Sadwick, ¶[0080]; Powell, 1:18-22; §VIII.C.3.

(h) Limitations [1a]-[1b]: a lamp tube; two end caps, each having an external connection terminal, and each coupled to a respective end of the lamp tube, wherein the external connection terminals are configured to receive an external driving signal;

166. See §§VIII.A.6(i)-VIII.A.6(j), VIII.B.4(h), VIII.C.3.

(i) Limitation [1c]: a rectifying circuit, coupled to the external connection terminals, for rectifying the external driving signal to produce a rectified signal;

167. Ivey813’s tube receives mains AC power from fixture 11 and, using power converter 36’s rectifier circuit—i.e., Ivey345’s rectifier 120 (“rectifying circuit”)—rectifies such power “to a DC wave” (“coupled to the external connection terminals, for rectifying the external driving signal to produce a rectified signal”). Ivey813, 2:51-56, 5:36-39; Ivey345, ¶¶[0012], [0015]-[0016]; §VIII.C.3.

- (j) Limitation [1d]: a filtering circuit, coupled to the rectifying circuit, for filtering the rectified signal to produce a filtered signal;**

168. Ivey345's rectifier 120 includes "a smoothing capacitor or other element which further processes the electrical current received [from] power input 105" ("filtering circuit, coupled to the rectifying circuit, for filtering the rectified signal to produce a filtered signal"). Ivey345, ¶[0015]; *see also* Ivey813, 5:36-39 ("Power converter 36 can include... a main filter circuit....").

- (k) Limitation [1e]: a driving circuit, coupled to the filtering circuit, for converting the filtered signal into a driving signal;**

169. Ivey345's current limiting circuit includes auxiliary power supply 125 ("driving circuit"), which is directly powered by rectifier 120 (and thus its smoothing capacitor) ("coupled to the filtering circuit") over device power rail 145 and supplies voltage ("for converting the filtered signal into a driving signal") for detector 150, comparator 170, Powell's RC oscillator, and other components in the current limiting circuit. Ivey345, ¶¶[0016]-[0019], [0024], [0029], [0031]; Powell, 7:23-35; §VIII.C.3.

- (l) Limitation [1f]: an LED module, coupled to the driving circuit, for emitting light based on the driving signal; and**

170. *See* §§VIII.A.6(k), VIII.B.4(h), VIII.C.3. Further, whether current flows through the LEDs—and thus whether the LEDs emit light—is determined by, e.g., detector 150, comparator 170, and Powell's RC oscillator, which are powered

by auxiliary power supply 125's supply voltage ("coupled to the driving circuit, for emitting light based on the driving signal"). Ivey813, 3:23-37, 3:43-47, 5:33-35; Ivey345, ¶¶[0010], [0016]-[0019], [0024], [0029]; Powell, 7:23-35; §VIII.C.3.

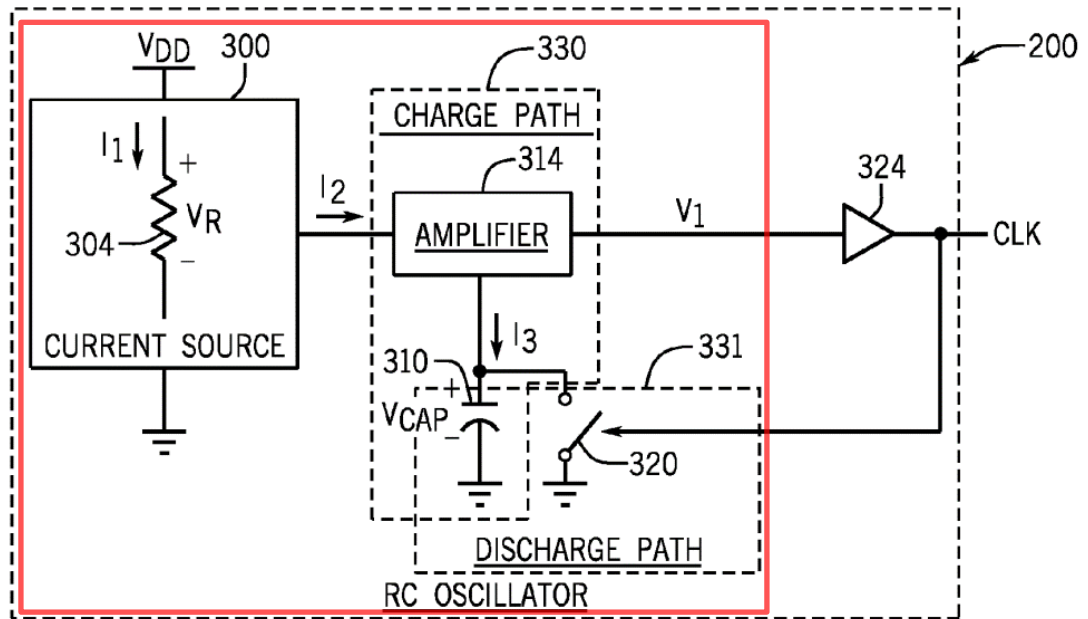
(m) Limitation [1g]: an installation detection module, configured to detect an installation state between the LED tube lamp and a lamp socket, wherein the installation detection module comprises:

171. Ivey345's current limiting circuit ("installation detection module") detects whether a normal or fault configuration exists ("configured to detect an installation state between the LED tube lamp and a lamp socket"). Ivey345, ¶¶[0010], [0013]; §VIII.C.3.

(n) Limitation [1h]: a first circuit, configured to generate a pulse signal, wherein the first circuit comprises a discharge path;

172. Powell's RC oscillator generates an oscillating signal V_1 and includes switch 320, which is a discharge path. Powell, 5:23-39, 4:65-67. Excluding digital buffer 324, each of the RC oscillator's other elements (solid-red) form the claimed "first circuit":

FIG. 3

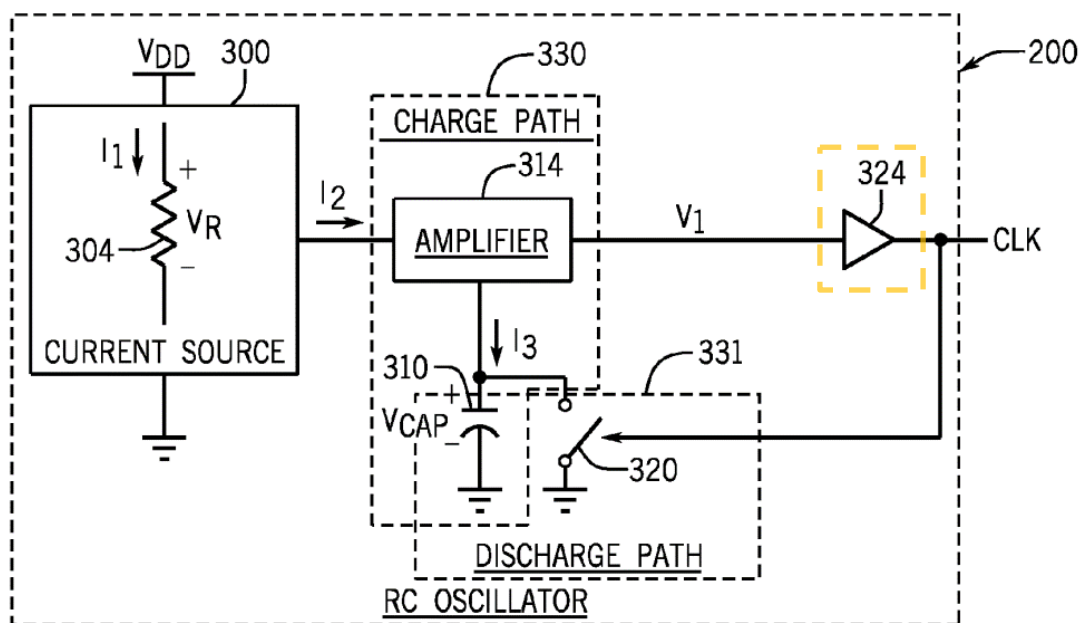


Powell, Fig.3; *see also* §VIII.C.4(a).

- (o) **Limitation [1i]: a second circuit, coupled to the first circuit and configured to receive and output the pulse signal; and**

173. The remaining buffer 324 (dotted-orange) forms the claimed “second circuit”:

FIG. 3



Powell, Fig.3, 6:1-5. As Powell teaches, buffer 324 receives the oscillating V_1 signal from amplifier 314 (“coupled to the first circuit and configured to receive...”) before pulse-shaping and outputting V_1 to other components such as switch 320 (“and output the pulse signal”). Powell, 5:13-39, 6:1-5; *see also* §VIII.C.4(c).

(p) **Limitation [1j]: a third circuit, coupled to a power loop of the LED tube lamp and the second circuit and configured to determine whether to conduct the power loop according to the pulse signal,**

174. In the Ivey-UL1993-Powell Combination, test load switch 135, load switch 175, or both form the claimed “third circuit,” as test load switch 135 opens and closes in response to the oscillations of the clock signal (here, from Powell’s RC oscillator), while load switch 175’s activation is controlled by devices such as detector 150 that are synchronized—and thus controlling load switch 175 according to—the clock signal (“coupled to a power loop of the LED tube lamp and the second

circuit and configured to determine whether to conduct the power loop according to the pulse signal”). *See* §§VIII.A.6(p), VIII.C.3.

175. In the Ivey-UL1993-Sadwick-Powell Combination, load switch 175 forms the claimed “third circuit,” as test load switch 135 opens and closes in response to the oscillations of the clock signal from Powell’s RC oscillator. *See* §§VIII.B.4(m), VIII.C.3.

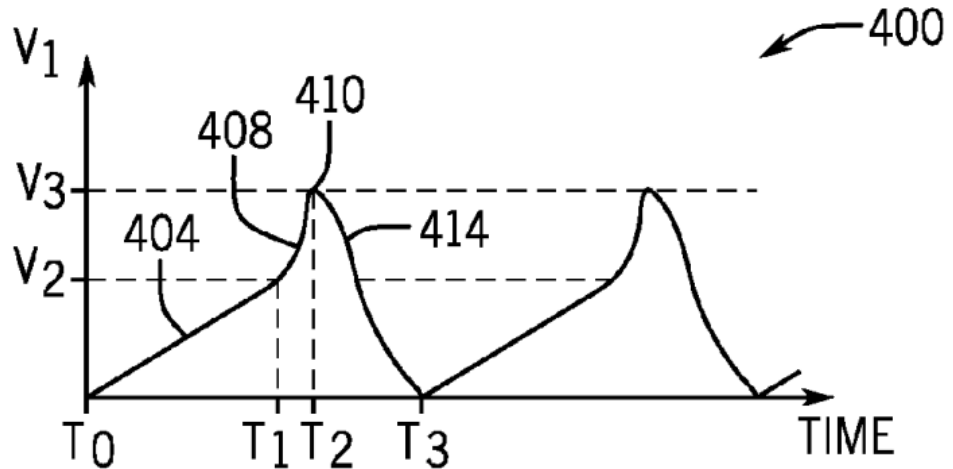
(q) Limitation [1k]: wherein the pulse signal is fed back to the discharge path of the first circuit, and the discharge path is conducted when the pulse signal is pulled to a high level voltage, and

176. V_1 is pulse-shaped and outputted to switch 320 of Powell’s RC oscillator such that, once V_1 reaches a high logic level, the pulse-shaped V_1 signal causes switch 320 to conduct. Powell, 5:29-39, 6:1-5; *see also* §VIII.C.4(c).

(r) Limitation [1l]: wherein the pulse signal is pulled to a low level voltage after the discharge path has been conducted for a predetermined time period.

177. By conducting switch 320, capacitor 310 discharges and V_1 decreases until reaching a low logic level, causing switch 320 to turn off and the oscillation cycle to repeat. Powell, 5:29-39; *see also* §VIII.C.4(d). This discharging part of the oscillation cycle occurs from T_2 to T_3 shown in Powell’s Figure 4:

FIG. 4



Powell, Fig.4, 6:34-38; *see also* §VIII.C.4(d).

- (s) **Claim 2:** The LED tube lamp according to claim 1, wherein the predetermined time period is a pulse-on period of the pulse signal.

178. From T_2 to T_3 in Powell's Figure 4, the pulse-shaped V_1 signal turns on switch 302 and is therefore high, while the reverse is true from T_0 to T_2 . *See* Powell, Fig.4, 6:34-38, 5:25-39; *see also* §VIII.C.4(e).

- (t) **Claim 3:** The LED tube lamp according to claim 1, wherein the discharge path is cut off when the pulse signal is pulled to the low level voltage.

179. When V_1 reaches a low logic level at the end of the discharging part of the oscillation cycle, switch 302 is turned off. Powell, 5:29-39; *see also* §VIII.C.4(f).

- (u) **Claim 5:** The LED tube lamp according to claim 1, wherein the installation detection module further comprises:
a fourth circuit, configured to detect a sampling signal

on the power loop so as to determine the installation state between the LED tube lamp and the lamp socket.

180. See §§VIII.A.6(n), VIII.B.4(k), VIII.C.3. Here, detector 150, comparator 170, and Z test load 140 altogether form the claimed “fourth circuit,” as these components detect variations on power rail 145 to determine whether a fault of normal configuration exists. Ivey345, ¶¶[0010], [0013], [0024]-[0026], [0030]-[0032], [0044]-[0045]; Sadwick, ¶¶[0080], [0082].

- (v) **Claim 6: The LED tube lamp according to claim 5, wherein the fourth circuit further compares the sampling signal with a predefined signal, the fourth circuit outputs a high level signal when a signal level of the sampling signal is greater than or equal to the predefined signal and outputs a low level signal when the signal level of the sampling signal is smaller than the predefined signal.**

181. More specifically, detector 150 outputs a signal representative of the detected variation to comparator 170, which compares the representative signal to the threshold signal and outputs a high signal when the representative signal is larger and a low signal when the representative signal is smaller. Ivey345, ¶¶[0010], [0024]-[0026], [0030]-[0032], [0044]-[0045]; Sadwick, ¶¶[0080], [0082]; §VIII.C.3.

- (w) **Claim 7: The LED tube lamp according to claim 6, wherein the third circuit is conducted in response to**

the high level signal so as to cause the power loop to remain conductive.

182. Comparator 170's high signal output causes load switch 175 to remain closed. Ivey345, ¶¶[0010], [0030]-[0032], [0041], [0044]-[0045]; Sadwick, ¶¶[0080], [0082]; §VIII.C.3.

(x) Claim 8: The LED tube lamp according to claim 6, wherein the third circuit is cut off in response to the low level signal so as to cause the power loop to remain open.

183. Comparator 170's low signal output turns off load switch 175. *See* §§VIII.A.6(m), VIII.B.4(j), VIII.C.3.

(y) Claim 9: The LED tube lamp according to claim 6, wherein the third circuit is cut off in response to the low level signal so as to reduce a current on the power loop less than 5 MIU (Measurement Indication Units).

184. Comparator 170's low signal output turns off load switch 175, limiting current to a safe level—e.g., <5MIU. *See* §§VIII.A.6(m), VIII.B.4(j), VIII.C.3.

(z) Claim 13: The LED tube lamp according to claim 12, wherein the detection pulse generating module comprises a discharge path, the pulse signal is fed back to the discharge path and the discharge path is conducted when the pulse signal is pulled to a high level voltage, and wherein the pulse signal is pulled to a low level voltage after the discharge path has been conducted for a predetermined time period.

185. *See* §§VIII.C.4(n), VIII.C.4(q)-VIII.C.4(r). For the same reasons that the discussed elements in Powell's RC oscillator meet limitation [1h]'s "first circuit," such elements meet claim 13's "detection pulse generating module."

(aa) Claim 14: The LED tube lamp according to claim 13, wherein the predetermined time period is the same as the pulse-on period of the pulse signal.

186. *See* §VIII.C.4(s).

(bb) Claim 15: The LED tube lamp according to claim 13, wherein the discharge path is cut off when the pulse signal is pulled to the low level voltage.

187. *See* §VIII.C.4(t).

IX. CONCLUSION

All statements made herein of my own knowledge are true, all statements made herein on information and belief are believed to be true, and these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. §1001.

Thursday, June 8, 2023

Date



Michael Lebby, Ph.D.

Appendix A

Michael Lebby



EDUCATION:

2004, Doctor of Engineering (D. Eng.)
University of Bradford, United Kingdom
Citation, “*Technical Contributions to Optoelectronics*”
(NB: This is a higher doctorate awarded on technical contribution to the field)

1987, Ph.D.
University of Bradford, United Kingdom
Thesis, “*Characterization and Fabrication of the HFET and BICFET*”

1985, MBA
University of Bradford, United Kingdom
Thesis, “*Small Business Planning for a Start-up*”

1984, Bachelors (B. Eng. – Honours)
University of Bradford, United Kingdom
Thesis, “*Computer Aided Testing of Semiconductor Devices*”

SUMMARY OF TECHNICAL EXPERTISE:

Industry roles (majority of career): Dr. Lebby has founded and led several companies in various positions including CEO and CTO (Ignis Optics, Oculi, One Chip Photonics, OIDA, Translucent Photonics, and Lightwave Logic). Dr. Lebby is currently Chairman & CEO of a public company (Lightwave Logic Inc. NASDAQ:LWLG). As CEO, Dr. Lebby led LWLG from an OTCQB company to OTCQX, and then to up-list on NASDAQ, organically, without raising financing (which is extremely rare), on 1st September 2021. Subsequently, Dr. Lebby was invited to ‘ring the bell’ and close the NASDAQ stock market for the week on 10th September 2021. The event was carried live on Fox, CNBC, Bloomberg, and BNN networks. On 1st September 2022, Lebby was elected Chairman of Lightwave Logic Inc.

Academia role (minor part of career): Dr. Lebby has been a full professor (part-time) in optoelectronics at Glyndŵr University, Wales, UK (2013-15). Dr. Lebby has over 60 publications and has a google scholar h-index = 46 (which includes issued patents and published patent applications), i10-index = 165, with over 8400 citations.

Key professional bodies: Dr. Lebby is a Fellow of the National Academy of Inventors (NAI), the IEEE (Institute of Electrical and Electronic Engineers), and the OSA (Optical Society of America). Dr. Lebby is a Chartered Engineer of the British Institute of Electrical Engineers (roughly equivalent to the professional engineer status in USA).

Dr. Lebby started work in telecommunications industry and has generated over 40 years of experience in a number of technical disciplines and technologies. Dr. Lebby is well versed in electronics, semiconductor physics, optoelectronics, optics, materials, packaging, module design, ICs and electrical engineering in general. Dr. Lebby has experience in commercial and industrial research of technologies such as silicon, compound semiconductors, manufacturing, fabrication, design, simulation, testing, evaluation, reliability, qualification of new ideas, concepts and products.

Dr. Lebby is co-inventor of the world's first 'oxide VCSEL' (this is a type of semiconductor laser) that is now being utilized for consumer applications (*Face ID of Apple's iPhone as an example, laser mice for PCs as another example*). US Patent #5359618 "High Efficiency VCSEL and Method of Fabrication" issued 25th October 1994. Estimated commercial volumes of this semiconductor device exceed many billions of units.

Dr. Lebby has over 230 issued utility patents with the USPTO in subjects such as electronics, optoelectronics, photonics, packaging, transceiver modules, optical sub-assemblies, materials, epitaxial growth, device design, assembly, and various active and passive components (both electronic and optoelectronic). Dr. Lebby regularly receives invites to speak at technical conferences as well as banking and financial conferences. Dr. Lebby has appeared in panels and interviews many times and regularly is communicating with the public on various platforms. Dr. Lebby is currently chairman of the International PIC conference based in Europe (since its conception in 2015). Dr. Lebby is inventor or co-inventor of ~230 issued USPTO utility patents (or over 450 if international derivatives are included), as well as over 80 published patent applications.

Dr. Lebby has participated in over 130 patent litigation cases as a technical expert witness, including over 20 trials and over 50 depositions. Dr. Lebby has authored numerous expert reports and is familiar with State (District), Federal (ITC) and PTAB-IPR court processes for expert witness testimony. Dr. Lebby has been cited in patent litigation case history (ITC investigation in the matter of: Certain Active Optical Cables and Products Containing the Same (ITC Inv #337-TA-1233)). See details below in Expert Witness Experience.

The types of products that Dr. Lebby understands and includes but are not limited to; Light Emitting Diodes (LEDs), Laser Diodes (LDs), photodetectors (PDs), optical waveguides, fiber optics, displays (LCD, LED, OLED), lighting luminaires, plastic photonics, optical polymers, sensors, LIDAR, solar cells, lighting, data communication, CMOS, and even new opportunities such as medical and life science applications for photonics. Dr. Lebby is internationally known for his work with integrated photonics, PICs (Photonic Integrated Circuits), silicon photonics, and semiconductor technologies such as InP, GaAs, III-GaN, silicon, as well as SiGe and silicon ICs (MOSFETs, FinFETs, bipolar), power FETs, RF FETs, various display technologies such as LCD, OLED, LED, cameras, as well as micro-fluidics and nanostructures/wires etc. Dr. Lebby has worked with DC current as well as AC current, high frequency design, microwave design, and multi-wavelength, visible wavelengths, in addition to 850nm/1310nm/1500nm/NIR fiber optic communications. Dr. Lebby has worked extensively in fiber optics which includes Fiber based systems, chassis', trays, modules, adapters, splice devices, connectors, transceivers, packaging as well as architecture and optical communication standards/protocols.

Dr. Lebby is currently CEO of a public company (Lightwave Logic Inc. NASDAQ:LWLG). As CEO, Dr. Lebby took LWLG from an OTCQX company to up-list on NASDAQ, organically, without raising financing (which is extremely rare). LWLG was listed on NASDAQ 1st September 2021, and Dr. Lebby was invited to close the NASDAQ stock market on 10th September 2021 and "ring the bell". The event was carried on Fox, CNBC, Bloomberg, and BNN networks.

BIOGRAPHY:

Biography: Michael S. Lebby joined Lightwave Logic as a member of the Board of Directors in 2015. In May 2017, Dr. Lebby assumed the role of CEO, and in September 2022, Chairman and CEO of Lightwave Logic Inc (NASDAQ:LWLG). Lightwave Logic is a technological company commercializing Electro-Optical polymers and successfully up listed the company to NASDAQ on 1st September, 2021. Dr. Lebby was invited to close the NASDAQ stock market on 10th September 2021. The event was carried on Fox, CNBC, Bloomberg, BNN networks.

Dr. Lebby (born 1961, London, UK) is an Anglo-American entrepreneur and intrapreneur in the fields of optoelectronics/photonics electronics and semiconductors. Dr. Lebby's career started with the British Government in 1977 in telecommunications and he did research at their research labs (RSRE Malvern) in the early 1980s. Dr. Lebby worked at AT&T's research labs: Bell Labs (1985-1989) in photonics, and subsequently drove the development (and co-authored the first patent) of the oxide VCSEL diode laser at Motorola in the 1990s (which is now used in laser mice, 3D structured light sensing/FaceID in mobile phones, optical interconnects; where volumes of the laser are over 1B units today). From 2005-2010 he led the USA trade association in optoelectronics (OIDA) and represented the optoelectronics and photonics industry on Capitol Hill.

Dr. Lebby has led and run technical start-ups and commercialized optoelectronic and photonics technology into volume manufacturing. Dr. Lebby has also had roles as a Venture Capitalist specializing in Optical Communications. He is currently a technical expert to the European Commission. He is a Fellow member of NAI (National Academy of Inventors), IEEE, and OSA, and has been voted PIC (Photonic Integrated Circuit) business leader of the year by the PIC International Conference in 2018.

Dr. Lebby holds over 450 issued international patents in photonics and electronics, that have been derived from over 230 issued USPTO utility patents, mostly in the field of optoelectronics, photonics, and semiconductors. He has been cited by the USPTO to be in the most prolific 75 inventors in USA from 1988-1997.

Dr. Lebby is passionate about photonics and has focused his efforts over the last 30 years to drive new photonics manufacturing programs in USA and Europe as well as industry-based photonics technology roadmaps.

Dr. Lebby is also passionate about optics and philately, and has been elected to both the London Guild of Spectacle Makers as well as the Royal Philatelic Society London.

WORK HISTORY:

2003 – Present

Oculi LLC, CEO and CTO (*part-time consulting*)

Oculi LLC provides consulting in expert witness, trial, deposition, expert reports, infringement, invalidity, and various patent and IP litigation in photonics, optoelectronics, semiconductors, and fiber optic telecommunication technology segments. Engaged patent agencies have included: IMS Expert Services, Thomson Reuters Expert Witness Services (now Round Table Group), LitXpert Expert Witness Group, Teklicon Expert Witness Agency, Beche Expert Services Group, Forensis Group: Expert Witness Services, and Expertconnect. Oculi LLC also provides consulting to Ambature Inc. in superconductivity.

2015 – Present

Lightwave Logic (NASDAQ:LWLG), Chairman, CEO, & Director, Board of Directors

In 2015 Dr. Lebby became a director of Lightwave Logic to assist in the company for competitive optical modulator products and associated packaging, manufacturing, and technology roadmaps/marketing. In May 2017, Dr. Lebby became CEO of Lightwave Logic. On 1st September 2021, Dr. Lebby successfully guided Lightwave Logic to up-list to NASDAQ, and was invited to ring the closing bell on 10th September 2021. The NASDAQ up-list was organic i.e. no reverse split, no raised funds. The organic up-list is considered very rare in the financial industry. In September 2022, Lebby became Chairman and CEO of Lightwave Logic Inc.

2014 – 2016

University Southern California, Director CFR (*Corp & Foundation Relations*)

Dr. Lebby assisted USC Viterbi Engineering to foster tighter faculty-industry relationships in high technology, IT, social media, graphic arts, electronics, photonics (solar, display, medical) and fiber communications segments.

2013 – Present

European Commission, Technical Expert

In 2013 Dr. Lebby became a technical expert for the Photonics Unit of the European Commission. Dr. Lebby has participated in organizing workshops, lectures, evaluating photonics proposals, and advising the Commission on funded projects. Dr. Lebby currently is an advisor on 7 photonics pilot lines (MIRPHAB, PI-SCALE, PIX4LIFE, PIXAPP, InPULSE, Phabulous, PhotonHub) and photonics based cardiovascular disease programs (CARDIS and InSide). More recently, Dr. Lebby has been consulting on larger framework (multi-country) projects that include electronics (power/RF) as well as photonic based technologies. Work includes displays, LEDs, lighting/LED luminaires, OLEDs, micro-optics, InP/Silicon photonics, near infra-red technologies, fiber optics, sensing, medical photonics, and medical imaging, technology roadmapping, electronics, IC design etc.

2013 – 2015

OneChip Photonics Corporation, President and CEO

In 2008 Dr. Lebby was elected independent board member for One Chip Photonics Inc. He was elected CEO in 2013. One Chip Photonics focused on technical and business operational strategy for communications based InP Photonic Integrated Circuit (PIC) and optoelectronic Integrated Circuit (OEIC) platforms.

2013 – 2015

Glyndŵr University, Professor, Chair of Optoelectronics

In 2013 Dr. Lebbby became full Professor of Optoelectronics (part-time) to assist Glyndwr University to position itself as a leader in optoelectronics and photonics. Areas of focus include design, simulation, and testing of photonic integrated circuits (PICs) and optoelectronics integrated circuits (OEICs), laser diodes, displays, optics, and solar cells.

2010 – 2013

Translucent, Inc., GM and CTO

Dr. Lebbby positioned Translucent on the product development and manufacture of epitaxial semiconductor wafers for the solar, power and lighting industries. Dr. Lebbby led the R&D and development of MBE based rare earth oxide single crystal epitaxial layers deposited onto large silicon wafers. On top of these wafers both MBE and MOCVD Gallium Nitride epitaxial device layers were grown for devices. The use of GaN-on-Si is expected to be a strong catalyst for change in the power electronics and LED lighting industries. In a parallel program at Translucent, Dr. Lebbby led the development efforts to develop and productize Germanium-Tin (GeSn) template wafers onto large format silicon wafers (Ge-on-Si) to enable cost effective, and ultra-high efficiency multi-junction solar cells for the CPV industry. Areas of advanced interconnect using new and novel material compounds were explored.

2005 – 2010

OIDA (Optoelectronic Industry Development Association), Executive Director, President, and CEO (Board Member)

Dr. Lebbby represented the optoelectronics industry and organized technical conferences/workshops/forecasts with industry roadmaps. Initiated green photonics metrics. Dr. Lebbby positioned OIDA as a national resource in the field of optoelectronics and has represented industry in many capacities ranging from talks, papers, expert witness, testimony, market and technical reports. Dr. Lebbby created *new industry-based initiatives* in fiber optics broadband as well as the green photonics movement (solar technologies, displays, LED lighting technologies) that is now occurring globally.

2003 – 2005

OCLARO, VP Technology and Business Development

Telecommunication optoelectronic components, San Jose, Ca. Focus on technology strategy for components and sub-systems.

2001 – 2003

Ignis Optics, President and CEO (Founder/Board Member)

Venture-backed start-up, San Jose, California manufacturing 10Gbps and OC192/OC48 fiber optic transceivers with micro-controllers using the XFP form-factor.

1999 – 2001

Intel Capital, Director Business Development/Investor (w/Board observer positions on Investment)

Intel Capital, Santa Clara, California. In 1999, Dr. Lebbby joined Intel as a corporate investor and was responsible for sourcing, negotiating, and closing private placement equity deals in the optical networking, component, display, projection technologies, LED lighting, LED luminaires, and semiconductor arenas.

1998 – 1999

TE Connectivity, Director Technology/BD (Fiber Optics)

Global Optoelectronics Division: Technology strategy for optical communications products.

1989 – 1998

Motorola, R&D Manager

Corporate R&D Labs, Tempe, Arizona. Optoelectronics: VCSEL based product solutions (OPTOBUS); materials, devices, packaging, systems. Other technologies included displays, field emission, LED, LCD, OLED, virtual/micro and projection. At the time, Dr. Lebby was also the lead inventor in Motorola's history with over 150 issued utility patents. Dr. Lebby worked in the silicon and compound semiconductor fabrication plants (fabs) to become proficient in deposition/etching/alignment tooling as well as design and simulation.

1985 – 1989

AT&T, Researcher

AT&T Bell Labs - Photonics Research Dept (Dept 11366), Holmdel, NJ. Dr. Lebby designed and fabricated new GaAs and InP optoelectronic and electronic devices that were grown both by MOCVD and MBE for projects that included optical computing and fiber optic communications.

1977 – 1984

UK Ministry of Defense, Apprenticeship/Journeyman + Electronics Engineer (REME – Royal Electrical and Mechanical Engineers, and RSRE – Royal Signals and Radar Establishment)

Dr. Lebby started his career at the Royal Electrical and Mechanical Engineer (REME) division of the Ministry of Defence in the UK. Lebby was a telecommunications apprentice, and repaired all types of radio/RF communications equipment. Lebby qualified as a fully qualified Journeyman or Apprentice specializing in telecommunications in 1980. Dr. Lebby moved to the Royal Signal and Radar Establishment (RSRE) to study material and characterization issues of GaAs and InP devices.

SELECTED PROFESSIONAL ACTIVITIES & AWARDS:

- Elected Chairman of Lightwave Logic Inc., NASDAQ:LWLG 1st September 2022
- Elected to the Corporate Engagement Council (newly formed OIDA to represent the global optical industry) for Optica in June 2022.
- Invited to ring the closing bell of NASDAQ (with associated TV interviews) on 10th September, 2021
- Elected Fellow of the **National Academy of Inventors (NAI)** in 2020.
- Voted winner at the PIC Conference (Photonic Integrated Circuits) as **PIC Entrepreneur and Business Leader of the Year** (March 2018).
- Dr. Lebby is **co-inventor of the oxide VCSEL** (semiconductor laser) that is now being utilized for consumer applications (*Face ID of Apple's iPhone as an example*). US Patent #5359618 "High Efficiency VCSEL and Method of Fabrication" issued 25th October 1994.
- Dr. Lebby was recognized professionally as a **Fellow of IEEE (2005) and OSA (2007)** with his technical contributions to the field of optoelectronics.
- Dr. Lebby is a member of the Fellows review committee of IEEE.
- As an inventor Dr. Lebby has achieved **>230 issued utility patents with the USPTO**.
- As an inventor Dr. Lebby has ~80 published utility patent applications with the USPTO
- As an inventor Dr. Lebby has over 450 issued patents world-wide if international derivatives are counted.
- Dr. Lebby's novel laser-based device, packaging, modules designs led Motorola to sell their patent portfolio independently where a number of the patents have "very high licensing coefficients." Dr. Lebby was given a special award from the Chairman of Motorola for exemplary patent invention accomplishments in 1998 and # **1 prolific inventor in Motorola's history**.
- **Over 60 publications** (www.linkedin.com/in/lebbby)
- **Over 300 public media activities** (that include: Books, Chapters, Reports, Abstracts, Videos, Lectures, Speeches, Reviews, Courses, Talks, Invited Talks, Keynote Talks, Plenary Talks, Webinars, Interviews, Articles, etc.). See at www.linkedin.com/in/lebbby
- Author of OIDA's **annual market optoelectronics report** and forecast (2009 version is over 600 pages), which receives international exposure and recognition. Regularly interacts with government agencies in Washington DC on photonics-based projects (DARPA, ARPA-E, NIH, NSF, DOE, NIST, DoD etc.). Typical chapters included: LEDs, laser diodes, fiber optic communications, sensors, displays, solar, green photonics, military photonics, and applications of photonics such as solid-state lighting (LED luminaires), automotive, medical, etc.

- Is the recipient of a **2nd doctorate** (higher) from Bradford University, UK, and only the second in the universities history to receive a D.Eng from industry (rest being academia).
- **Intreprenuer** at: (i) Motorola: Co-founded Optobus division – VCSEL laser based parallel optical interconnect solution, and (ii) Intel: Co-founded the Intel optics division for silicon photonics where over \$300M was initially invested for the division.
- **Entrepreneur**: Founded (and CEO) Ignis Optics Inc., a venture backed company (>\$30M) that designed and manufactured 10Gbps fiber optic transceivers. Sold the company to Bookham (NASDAQ: BKHM) in 2003. Restructured OneChip Photonics (as CEO) through bankruptcy, and new VC-based funding. Assisted in the raising of >\$50M VC funding as a member of BoD. Founded Oculi LLC and Obsidian Motors LLC.
- IEEE CPMT **Board of Governors** ('98- '02); IEEE Phoenix Waves and Devices Junior Engineer of the Year (1993); CPMT Distinguished lecturer (2000), CPMT technical committee (TC-10 & ECTC) 1991 to 2011
- Advised at **Board of Director** level for a number of technical start-ups
- **Chartered Engineer** (C.Eng) from IEE (UK). The chartered engineering status is equivalent to the US PE (professional engineer)

EXPERT WITNESS EXPERIENCE

Summary:

Depositions (total-to-date) >50

Trial/Hearing/Court appearances >20 (with IPR/PTAB ‘paper trial’, this total increases to >25)

Cited patent litigation case history: In essence, the following case history means that the expert doesn’t have to disclose every minute detail in his expert report. He is allowed to disclose theories in the report and expand on them in his witness statement.

See also In The Matter Of Certain Light-Emitting Diode Products, Systems, And Components Thereof, Inv. No. 337-TA-1168, Order No. 34, 2020 WL 1026335 (Feb. 14, 2020) (denying motion *in limine* to preclude testimony where: “[t]he invalidity theories at issue were previously disclosed at least in Dr. Lebby’s expert report, and LSG had the opportunity to test these theories at Dr. Lebby’s deposition.”)

See case # 81 below

Patent litigation cases engaged:

1. Active case work: 1Q2009 (March 24th 2009); *Testimony: US-China Economic and security review commission on the optoelectronics industry. US Congress, Capitol Hill*; Written statement on the status of the USA optoelectronics industry with aural cross-examination by the commission. Trial experience.
 - a. Deposition: 0 (Cumulative total: 0)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 1)
 - c. Technology: Optoelectronics (optical storage, fiber optic communications, sensors, high power lasers, LED lighting, LED luminaires etc.).
2. Active case work: 3Q2010-1Q2011; *Finisar Corp. v. Optical Communication Products Inc.*, No. 10-CV-05617 and No. 11-cv-00104 (retained by plaintiff - Morgan, Lewis & Bockius LLP).
 - a. Deposition: 0 (Cumulative total: 0)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 1)
 - c. Technology: semiconductor lasers/VCSLs, fiber optic transceiver modules
3. Active case work: 1Q2011; *Ziptronix, Inc. v. OmniVision Technologies, Inc., Taiwan Semiconductor Manufacturing Company Ltd., and TSMC North America Corp.*, No. 11-CV-5235 (retained by plaintiff – Alston Bird LLP).
 - a. Deposition: 0 (Cumulative total: 0)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 1)
 - c. Technology: CMOS image sensors; design and fabrication
4. Active case work: 3Q2011 to 3Q2012; *Certain Light-Emitting Diodes and Products Containing Same*, Inv. No. 337-TA-798 (USITC filed July 15, 2011) (retained by respondent Samsung – Covington & Burling LLP). Deposition (x2) and trial experience.
 - a. Deposition: 3 (Cumulative total: 3)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 2)
 - c. Technology: LEDs, device design, color gamut, packaging, optical lensing, lead frames, surface mount packaging.
5. Active case work: 3Q2011 to 2Q2015; *Cheetah Omni, LLC v. Alcatel-Lucent USA Inc.*, No. 11-CV-390 (E.D. Tex. filed July 29, 2011) (retained by plaintiff – Brooks Kushman). Deposition experience (x2).
 - a. Deposition: 1 (Cumulative total: 4)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 2)
 - c. Technology: Fiber optic networks, optical switches, ROADMs and optical filters (dielectric based).
6. Active case work: 4Q2012 to 3Q2014; *Finisar Corp. v. Cheetah Omni, LLC*, No. 11-CV-15625 (E.D. Mich. filed Dec. 23, 2011) (retained by defendant – Brooks Kushman). Deposition experience (x1).
 - a. Deposition: 1 (Cumulative total: 5)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 2)
 - c. Technology: Wavelength optical switches, optical filters, and optical components, liquid crystal technology.
7. Active case work: 4Q2012 to 3Q2013; *Certain Optoelectronic Devices for Fiber Optic Communications, Components Thereof, and Prods. Containing the Same*, Inv. No. 337-TA-860 (USITC filed Sept. 24, 2012) (retained by respondent – Mellanox, IPtronics and FCI Inc and counsel Alston & Bird LLP). Deposition (x2) and trial experience.
 - a. Deposition: 2 (Cumulative total: 7)

- b. Trial/Hearing/Court appearance: 1 (Cumulative total: 3)
 - c. Technology: IC design, layout, and operation; especially laser driver chips for VCSELs. High speed laboratory testing.
- 8. Active case work: 3Q2014 to 2Q2015; *Microscan Sys., Inc. v. Cognex Corp.*, No. 14-CV-6952 (S.D.N.Y. filed Aug. 27, 2014) (retained by plaintiff – Morrison & Foerster LLP). Deposition (x1) and trial experience.
 - a. Deposition: 1 (Cumulative total: 8)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 4)
 - c. Technology: Bar code scanners and associated optics such as imagers, lasers, LEDs, molded optics. Laboratory testing.
- 9. Active case work: 2Q2014 to 1Q2016; *Avago Techs. Fiber IP (Singapore) PTE Ltd. v. IPtronics Inc.*, No. 10-CV-2863 (N.D. Cal. filed June 29, 2010) (retained by respondent – Alston & Bird LLP).
 - a. Deposition: 0 (Cumulative total: 8)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
 - c. Technology: IC design, layout, and operation; especially laser driver chips for VCSELs. High speed laboratory testing.
- 10. Active case work: 1Q2015 to 3Q2015; *Regarding certain optical disc drives*, Inv. No. 337-TA-897 (USITC filed Oct. 21, 2013) (retained by respondent – O'Melveny & Myers LLP).
 - a. Deposition: 0 (Cumulative total: 8)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
 - c. Technology: CD, CVD, BluRay optical disk drives, optical components, laser diodes, and optical beam patterns. Laboratory testing of visible optics.
- 11. Active case work: 1Q2015 to 2Q2015; *BMW of N. Am., LLC v. Innovative Display Techs., LLC*, No. IPR2015-00933, IPR2015-00934 (P.T.A.B. filed Mar. 24, 2015) (retained by plaintiff – Crowell Moring LLP).
 - a. Deposition: 0 (Cumulative total: 8)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
 - c. Technology: LED backlights for vehicles; LED package and optical module/LED luminaire design.
- 12. Active case work: 1Q2015 to 2Q2015; *BMW of N. Am., LLC v. Innovative Display Techs., LLC*, No. IPR2015-00934 (P.T.A.B. filed Mar. 24, 2015) (retained by plaintiff – Crowell Moring LLP).
 - a. Deposition: 0 (Cumulative total: 8)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
 - c. Technology: LED backlights for vehicles; LED package and optical module/luminaire design.
- 13. Active case work: 1Q2015 to 3Q2016; *OneChip Photonics Inc.*, Pre-litigation IP Case No. TBD; (retained by plaintiff – Patent Monetization Inc. (PMI)).
 - a. Deposition: 0 (Cumulative total: 8)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
 - c. Technology: Photonic Integrated Circuits using InP (Indium Phosphide); lasers, detectors, waveguides, mux/demux, spot size converters.
- 14. Active case work: 2Q2016; *IDT v. Hyundai Motor Co.*, No. 14-CV-201 (E.D. Tex. filed May 4, 2015) (retained by defendant – DLA Piper LLP).
 - a. Deposition: 0 (Cumulative total: 8)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
 - c. Technology: LED devices, packages and modules/luminaires for vehicles.
- 15. Active case work: 1Q2015 to 3Q2015; *Cree Inc., v. Honeywell Int'l Inc.*, No. 3:14-CV-737 (W.D. Wisc. filed Oct. 28, 2014) (retained by defendant - Arnold & Porter LLP). Deposition experience (x1).
 - a. Deposition: 1 (Cumulative total: 9)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 4)
 - c. Technology: LEDs for mobile phones; LED epitaxial layers, device designs, optical lensing, packaging. Laboratory reverse engineering using TEM/SEM/EDAX etc.
- 16. Active case work: 2Q2015 to 4Q2015; *Trs. of Boston Univ. v. Everlight Elecs. Co.*, Nos. 12-CV-11935, 12-CV-12326, 12-CV-12330 (D. Mass. filed Oct. 17, 2012) (retained by plaintiff - Shore Chan DePumpo LLP). Deposition (x1) and trial experience.
 - a. Deposition: 1 (Cumulative total: 10)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 5)
 - c. Technology: GaN buffer layers for LEDs, and associated technical marketing, sales and import process into USA.
- 17. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech. Corp.*, No. 12-CV-1063 (D. Del. filed Aug. 22, 2012) and IPR2015-01659 (PTAB filed Jul. 31st 2015) (retained by plaintiff – DLA Piper & Nixon Law). IPR deposition (i.e. trial) experience (x1).
 - a. Deposition: 1 (Cumulative total: 11)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 1)
 - d. Technology: Optical storage using laser diodes, photodetectors and optical materials

18. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech. Corp.*, No. 12-CV-1063 (D. Del. filed Aug. 22, 2012) and IPR2015-01642 (PTAB filed Jul. 30th 2015) (retained by plaintiff – DLA Piper & Nixon Law).
 - a. Deposition: 0 (Cumulative total: 11)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)
 - d. Technology: Optical storage using laser diodes, photodetectors and optical materials
19. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech. Corp.*, IPR2016-01677 (PTAB filed Aug. 24th 2016) (retained by plaintiff – DLA Piper & Nixon Law).
 - a. Deposition: 0 (Cumulative total: 11)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)
 - d. Technology: Optical storage using laser diodes, photodetectors and optical materials
20. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech. Corp.*, IPR2015-01678 (PTAB filed Aug. 24th 2016) (retained by plaintiff – DLA Piper & Nixon Law).
 - a. Deposition: 0 (Cumulative total: 11)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)
 - d. Technology: Optical storage using laser diodes, photodetectors and optical materials
21. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech. Corp.*, IPR2015-01644 (PTAB filed Jul. 30th 2015) (retained by plaintiff – DLA Piper & Nixon Law).
 - a. Deposition: 0 (Cumulative total: 11)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)
 - d. Technology: Optical storage using laser diodes, photodetectors and optical materials
22. Active case work: 3Q2015 to 3Q2016; *LG Elecs. Inc. v. Toshiba Samsung Storage Tech. Corp.*, IPR2015-01653 (PTAB filed Jul. 31st 2015) (retained by plaintiff – DLA Piper & Nixon Law).
 - a. Deposition: 0 (Cumulative total: 11)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)
 - d. Technology: Optical storage using laser diodes, photodetectors and optical materials
23. Active case work: 3Q2015; *Heptagon* Pre-litigation IPR petition; (retained by plaintiff – Proskauer Rose LLP).
 - a. Deposition: 0 (Cumulative total: 11)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 1)
 - d. Technology: Proximity sensors using LEDs, photodetectors and innovative semiconductor packaging.
24. Active case work: 1Q2016 to 2Q2017; *Dentsply v. Am. Orthodontics Inc.*, No. 15-CV-1706 (D. Pa. filed Sept. 1, 2015) and IPR2016-01652 (PTAB filed Aug. 19th 2016) (retained by defendant – Godfrey Kahn LLP). IPR deposition (x1) experience.
 - a. Deposition: 1 (Cumulative total: 12)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 2)
 - d. Technology: High power lasers (YAG, CO2) to engrave and scribe dental orthodontic brackets.
25. Active case work: 2Q2016 to 2Q2017; *Koninklijke Philips N.V. v. Elect-tech Int'l (H.K.)*, No. 14-CV-2737 (N.D. Cal. filed Aug. 12, 2015) (retained by plaintiff – Reed Smith LLP).
 - a. Deposition: 0 (Cumulative total: 12)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)
 - d. Technology: Trade secret MOCVD epitaxial growth techniques for high power GaN/InGaN LED technology, luminaires, modules and packaging.
26. Active case work: 2Q2016 to 4Q2016; *Bluestone Innovations llc. v. E. Mishan & Co. Inc.*, Pre-litigation IP Case No. TBD; (retained by defendant - Notaro, Michalos, & Zaccaria P.C.).
 - a. Deposition: 0 (Cumulative total: 12)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)
 - d. Technology: GaN/InGaN LEDs on structured substrates with reverse engineering laboratory analysis.
27. Active case work: 3Q2016-1Q2017; *511 Innovations Inc. v. HTC Am., Inc.*, No. 15-CV-1524 (E.D. Tex. Filed June 30, 2016) (retained by plaintiff – The Davis Firm). Deposition (x2)
 - a. Deposition: 2 (Cumulative total: 14)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)
 - d. Technology: Proximity sensors for mobile phones.
28. Active case work: 3Q2016-4Q2016; *MellanoX Techs. Ltd. v. Methode Elecs. Inc.*, No. 15-CV-3730 (N.D. Cal. filed Aug. 16, 2015) (retained by plaintiff – Alston & Bird).

- a. Deposition: 0 (Cumulative total: 14)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)
 - d. Technology: Fiber optic transceiver modules.
- 29. Active case work: 4Q2016-1Q2017; *Novanta Inc., v. Iridium Inc.*, No. 15-CV-01033 (D. Del. filed Nov. 9, 2015) (retained by defendant – Barnes and Thornburg LLP).
 - a. Deposition: 0 (Cumulative total: 14)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)
 - d. Technology: High power gas laser design and operation.
- 30. Active case work: 1Q2017-1Q2017; *Optolium Inc., v. Cree Inc.*, No. 16-CV-03828; (D. Az. filed Nov. 3, 2016) (retained by defendant – Jones Day).
 - a. Deposition: 0 (Cumulative total: 14)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 2)
 - d. Technology: LED packaging for illumination. LED luminaires.
- 31. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI), v. Willis Electric Co., Ltd.*, 15-CV-00552 (W.D. NC. Filed: Apr 21st 2016), (retained by plaintiff - Troutman Sanders LLP). Deposition experience (x2)
 - a. Deposition: 2 (Cumulative total: 16)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 3)
 - d. Technology: Electrical connector, IC, and LED light product design including luminaires.
- 32. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI), v. Willis Electric Co., Ltd.*, IPR2017-00309 (PTAB filed Nov. 21st 2017), (retained by plaintiff - Troutman Sanders LLP).
 - a. Deposition: 0 (Cumulative total: 16)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Electrical connector, IC, and LED light product design including luminaires.
- 33. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI), v. Willis Electric Co., Ltd.*, IPR2017-00330 (PTAB filed Nov. 24th 2017), (retained by plaintiff - Troutman Sanders LLP).
 - a. Deposition: 0 (Cumulative total: 16)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Electrical connector, IC, and LED light product design including luminaires.
- 34. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI), v. Willis Electric Co., Ltd.*, IPR2017-00331 (PTAB filed Nov. 24th 2017), (retained by plaintiff - Troutman Sanders LLP).
 - a. Deposition: 0 (Cumulative total: 16)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Electrical connector, IC, and LED light product design including luminaires.
- 35. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI), v. Willis Electric Co., Ltd.*, IPR2017-00332 (PTAB filed Nov. 25th 2017), (retained by plaintiff - Troutman Sanders LLP).
 - a. Deposition: 0 (Cumulative total: 16)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Electrical connector, IC, and LED light product design including luminaires.
- 36. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI), v. Willis Electric Co., Ltd.*, IPR2017-00334 (PTAB filed Nov. 25th 2017), (retained by plaintiff - Troutman Sanders LLP).
 - a. Deposition: 0 (Cumulative total: 16)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Electrical connector, IC, and LED light product design including luminaires.
- 37. Active case work: 1Q2017-4Q2017; *Polygroup Macau Ltd (BVI), v. Willis Electric Co., Ltd.*, IPR2017-00335 (PTAB filed Nov. 25th 2017), (retained by plaintiff - Troutman Sanders LLP).
 - a. Deposition: 0 (Cumulative total: 16)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Electrical connector, IC, and LED light product design including luminaires.
- 38. Active case work: 1Q2017-4Q2017; *Macom Technology Solutions Holdings Inc., and Nitronex, LLC, v. Infineon Technologies AG and Infineon Technologies North American Corp.*, 16-CV-02859 (C.D. Ca. filed Apr 26, 2016) (retained by plaintiff – Baker Botts LLP).
 - a. Deposition: 0 (Cumulative total: 16)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)

- d. Technology: High performance GaN based RF FET device design and operation.
39. Active case work: 1Q2017-1Q2017; *Quanergy Systems, Inc. v. Velodyne LiDAR, Inc.* (16-cv-05251; N.D. Ca. filed: Sep 13th 2016 (retained by plaintiff Velodyne) - Latham & Watkins LLP
 - a. Deposition: 0 (Cumulative total: 16)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Laser/photodetector based LIDAR design and operation for self-driving vehicles.
40. Active case work: 1Q2017-2Q2017; *The Chamberlain Group Inc., v. Techtronic Industries Co., Ltd, Techtronic Industries North America et al.*, Challenge to U.S Patent No. 7,862,209 (retained by plaintiff – The Chamberlain Group) – Morgan, Lewis & Brockius, LLP.
 - a. Deposition: 0 (Cumulative total: 16)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 5)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: LED based luminaire design for lighting.
41. Active case work: 1Q2017-1Q2018; *Uber Technologies Inc., Ottomotto LLC., Otto Trucking LLC., v. Waymo LLC (Google)*, 17-CV-00939 (N.D. Ca filed: Mar 10th, 2017), (retained by defendant Uber Technologies Inc.) – Morrison and Foerster LLP. Deposition experience (x3) and trial experience (case settled at trial).
 - a. Deposition: 3 (Cumulative total: 19)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Optical and electrical device, optics, and package designs for LIDAR based self-driving vehicles.
42. Active case work: 2Q2017-2Q2017; *Heptagon v. ST Mircoelectronics* IPR petition; (retained by plaintiff Heptagon) – Proskauer Rose LLP.
 - a. Deposition: 0 (Cumulative total: 19)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Optoelectronic based proximity sensors using LEDs and photodetectors.
43. Active case work: 2Q2017-2Q2018; *AT&T Inc., v. Sycamore Holdings LLC.*, 16-CV-00588 (E. D. Tx filed: Jun 6th 2016); (retained by defendant AT&T Inc.) - Kirkland and Ellis LLP. Deposition experience (x1)
 - a. Deposition: 1 (Cumulative total: 20)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Coding designs of optical digital signals for high performance optical networks.
44. Active case work: 2Q2017 – 4Q2017; *Clearfield Inc., v. CommScope, ADC, Tyco, and TE Connectivity*, 17-CV-00307 (D.C. Minn. filed Jan 31st 2017); (retained by defendant Clearfield, Inc.) – Pepper Hamilton LLP
 - a. Deposition: 0 (Cumulative total: 20)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Fiber optic connectors, panels, and distribution switches using optoelectronic components.
45. Active case work: 2Q2017 – 4Q2017; *Clearfield Inc., v. CommScope, ADC, Tyco, and TE Connectivity*, IPR2017-02122 (PTAB filed Sep. 15th 2017); (retained by defendant Clearfield, Inc.) – Pepper Hamilton LLP
 - a. Deposition: 0 (Cumulative total: 20)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Fiber optic connectors, panels, and distribution switches using optoelectronic components.
46. Active case work: 2Q2017 – 4Q2017; *Clearfield Inc., v. CommScope, ADC, Tyco, and TE Connectivity*, IPR2018-00003 (PTAB filed Oct. 6th 2017); (retained by defendant Clearfield, Inc.) – Pepper Hamilton LLP
 - a. Deposition: 0 (Cumulative total: 20)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Fiber optic connectors, panels, and distribution switches using optoelectronic components.
47. Active case work: 2Q2017 – 4Q2017; *Clearfield Inc., v. CommScope, ADC, Tyco, and TE Connectivity*, IPR2018-00154 (PTAB filed Nov. 7th 2017); (retained by defendant Clearfield, Inc.) – Pepper Hamilton LLP
 - a. Deposition: 0 (Cumulative total: 20)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Fiber optic connectors, panels, and distribution switches using optoelectronic components.
48. Active case work: 4Q2016-2Q2017; *Antunes Inc.*, Pre-litigation IP patent review; Case No. TBD; (retained by plaintiff – Antunes Inc. and Chapman Spingola LLP).

- a. Deposition: 0 (Cumulative total: 20)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: High power grating surface emitter laser diodes, and associated packaging and device design for laser-based cooking ovens.
- 49. Active case work: 1Q2017-2Q2017; *Core Optical Technologies LLC v. Fujitsu Network Communications, Inc.*, 16-CV-00437 (C. D. Ca filed: Mar 7th 2016); (retained by defendant Fujitsu Network Communications) – Morrison & Foerster LLP.
 - a. Deposition: 0 (Cumulative total: 20)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Fiber optic based optical communications for coherent technologies
- 50. Active case work: 3Q2017-4Q2018; *Oyster Optics LLC v. Coriant America, et al*, 16-CV-01302 (E. D. Tx filed: Nov 24th 2016); (retained by plaintiff Oyster Optics LLC) – Russ August & Kabat LLP.
 - a. Deposition: 1 (Cumulative total: 21)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Fiber optic based optoelectronic semiconductor component design and operation.
- 51. Active case work: 3Q2017-4Q2018; *Oyster Optics LLC v. Infinera, Alcatel-Lucent, Fujitsu, Cisco Systems, Huawei*, 16-CV-01295, 16-CV-01297, 16-CV-01299, 16-CV-01301, 16-CV-01303 (E. D. Tx filed: Nov 24th 2016); (retained by plaintiff Oyster Optics LLC) – Russ August & Kabat LLP. Deposition experience (x1).
 - a. Deposition: 1 (Cumulative total: 22)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Fiber optic based optoelectronic semiconductor component design and operation. Including both direct detect and coherent communications, and encoding techniques such as PSK, QPSK, AM, FM etc.
- 52. Active case work: 3Q2017-4Q2017; *Olympus*, Pre-litigation IP and Due Diligence; Case No. TBD; (retained by plaintiff – Olympus and Fish & Richardson P.C.)
 - a. Deposition: 0 (Cumulative total: 22)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: High volume, low cost optical lens and optics technology.
- 53. Active case work: 3Q2017-1Q2018; *Honeywell International, Inc et al v. Code Corporation et al.*, ITC No 337-TA-1061 (filed Jun 28th 2017), “Certain barcode readers, scan engines, products containing the same, and components thereof,” (retained by respondent – Honeywell and Alston and Bird LLP)
 - a. Deposition: 1 (Cumulative total: 23)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Bar-code scanners and associated optical/optoelectronic component performance and operation.
- 54. Active case work: 4Q2017-1Q2019; *Godo Kaisha IP Bridge 1 v. Intel Corp.*, 17-CV-00676 (filed Sep 29th 2017), (retained by plaintiff – Godo Kaisha IP Bridge 1) - Ropes and Gray, LLP.
 - a. Deposition: 0 (Cumulative total: 23)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 6)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Fabrication, design, and reverse engineering of silicon-based FET ICs.
- 55. Active case work: 4Q2017-3Q2018; *Maxim Integrated Products, Inc. and Volterra Semiconductor LLC., v. Silicon Mitus Inc., and Silicon Mitus Technology Inc.*, 17-CV-03507 (N. D. Ca: filed Jun 16th 2017), (retained by defendant Silicon Mitus) – Pillsbury Winthrop Shaw Pittman, LLP. (Deposition and trial experience X1)
 - a. Deposition: 1 (Cumulative total: 24)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 7)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Fabrication, design, characterization, and packaging of silicon-based FET ICs for power applications
- 56. Active case work: 2Q2018-3Q2018; *Cree, Inc., v. Document Security Systems Inc.*, 17-CV-4263 (C.D. Ca filed: Apr 17th 2017), (retained by defendant Cree Inc.) - Jones Day, LLP
 - a. Deposition: 0 (Cumulative total: 24)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 7)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Design and packaging of high brightness GaN based LEDs for luminaires.
- 57. Active case work: 2Q2018-2Q2018; *Weisen v., Ram Telecom International (RTI).*, CGC-16-554331 (Sup Ca: filed 3rd May 2017) (retained by plaintiff Weisen, J) - Yetter Coleman, LLP. Deposition experience (x1) and trial experience (x1).

- a. Deposition: 1 (Cumulative total: 25)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Submarine and subsea fiber optic cables: technology, markets, economic impact, and history.
- 58. Active case work: 2Q2018-3Q2018; *Seoul Semiconductor, v. Document Security Systems Inc.*, 17-CV-00981 (C.D. Ca filed: Apr 17th 2017), (retained by defendant Seoul Semiconductor) - Latham and Watkins LLP
 - a. Deposition: 1 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Design and packaging of high brightness GaN based LEDs for luminaires.
- 59. Active case work: 3Q2018-4Q2018; *NEC Display Solutions Inc., and NEC Display Solutions of America, Inc., v. Ultravision, ITC Case# 337-TA-1114* (filed 24th May 2018), "Certain Modular LED Display Panels and Components Thereof," (retained by respondent Jones Day, LLP)
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: Large LED Panels, LED displays, LED modular panel design, LED thermal engineering and color displays for outdoor environments.
- 60. Active case work: 3Q2018-3Q2018; IFT (Innovative Foundry Technologies) (pre-lit), retained by plaintiff Mintz Levin, Cohen, Ferris, Glovsky, and Popeo PC.)
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 3)
 - d. Technology: CMOS device (inc FinFETs) and IC fabrication techniques at 40, 28, 20, 16nm nodes.
- 61. Active case work: 4Q2018-2Q2019; *Eidolon Optical LLC, v. Haag-Streit AG.*, IPR2018-01311, (retained by patent owner Eidolon Optical LLC) - McInnes & McLane LLP
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 4)
 - d. Technology: High brightness InGaAlP, GaP, AlGaAs, and GaN/InGaP based LEDs for use in medical instruments
- 62. Active case work: 3Q2018-3Q2018; *Voxtel Inc., v. Joseph Lachapelle & Luminar Technologies Inc.*, 18-CV-27356 (D. Or. filed: Dec 18th 2017), (retained by plaintiff Voxtel Inc.) - Ater Wynne LLP
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: LIDAR optical and electronic component and system technology
- 63. Active case work: 3Q2018-1Q2019; *Alta Devices, v. LG Electronics Inc.*, 18-CV-00404 (N.D. Ca. filed: May 7th 2018), (retained by defendant LG Electronics Inc.) - Hogan Lovells LLP
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Trade Secret GaAs based solar cell design, fabrication, manufacturing, and device performance
- 64. Active case work: 3Q2018-3Q18; *Opterna AM Inc., v. Commscope Technologies Inc.*, Pre-litigation preparation, (retained by defendant Opterna AM Inc.) - Sterne Kessler LLP
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Fiber optic connectors, panels, and distribution switches using optoelectronic components.
- 65. Active case work: 4Q2018 – 1Q2019; *U.D. Electronic Corp., v. Pulse Electronics, Inc.*, Preparation for IPR filing: IPR2019-00508 (PTAB filed Dec 26th 2018); and support for 18-CV-00373 (S.D. Ca. filed: Feb 16th 2018) (retained by petitioner U. D. Electronic Corp.) – Procopio, Cory, Hargreaves and Savitch LLP
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components.
- 66. Active case work: 4Q2018 – 1Q2019; *U.D. Electronic Corp., v. Pulse Electronics, Inc.*, Preparation for IPR filing: IPR2019-00515 (PTAB filed Dec 31st 2018); and support for 18-CV-00373 (S.D. Ca. filed: Feb 16th 2018) (retained by petitioner U. D. Electronic Corp.) – Procopio, Cory, Hargreaves and Savitch LLP
 - a. Deposition: 0 (Cumulative total: 26)

- b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components.
- 67. Active case work: 4Q2018 – 1Q2019; *U.D. Electronic Corp., v. Pulse Electronics, Inc.*, Preparation for IPR filing: IPR2019-00262 (PTAB filed Nov 9th 2018); and support for 18-CV-00373 (S.D. Ca. filed: Feb 16th 2018) (retained by petitioner U. D. Electronic Corp.) – Procopio, Cory, Hargreaves and Savitch LLP
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components.
- 68. Active case work: 4Q2018 – 1Q2019; *U.D. Electronic Corp., v. Pulse Electronics, Inc.*, Preparation for IPR filing: IPR2019-00511 (PTAB filed Dec 28th 2018); and support for 18-CV-00373 (S.D. Ca. filed: Feb 16th 2018) (retained by petitioner U. D. Electronic Corp.) – Procopio, Cory, Hargreaves and Savitch LLP
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components.
- 69. Active case work: 4Q2018 – 1Q2019; *Semiconductor Energy Laboratory Co. Ltd., v. Bluehouse Global Ltd.*, Preparation for IPR filing: IPR2018-01405 (PTAB filed Jul 18th 2018); (retained by patent owner SEL Co Ltd.) – Robinson Intellectual Law Office, P.C. (Counsel represented by Fish and Richardson LLP).
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Semiconductor displays using active matrix LCD and thin film transistor technology. Design, fabrication, and circuit layout.
- 70. Active case work: 4Q2018 – 1Q2019; *Semiconductor Energy Laboratory Co. Ltd., v. Bluehouse Global Ltd.*, Preparation for IPR filing: IPR2018-01393 (PTAB filed Jul 13th 2018); (retained by patent owner SEL Co Ltd.) – Robinson Intellectual Law Office, P.C. (Counsel represented by Fish and Richardson LLP)
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 8)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Semiconductor displays using active matrix LCD and thin film transistor technology. Design and fabrication technology.
- 71. Active case work: 4Q2018 - 1Q2019; *The Sloan Company dba SloanLED, v. Principle Lighting Group, LLC.*, 18-CV-06449 (C.D. Ca. filed: Jul 26th 2018), (retained by defendant Sloan LED.) - Ferguson Case Orr Paterson LLP
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 9)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: LED lighting, LED luminaires, LED performance, electrical and mechanical design and construction.
- 72. Active case work: 1Q2019 - 1Q2019; *HTC Corporation, v. Lemire Illumination Technologies.*, 18-CV-00021 (E.D. Tx. filed: Jan 21st 2018), (retained by defendant HTC Corporation) - Perkins Coie LLP
 - a. Deposition: 0 (Cumulative total: 26)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: LEDs for mobile phones
- 73. Active case work: 1Q2019 - 2Q2019; *Frys Electronics, v. Seoul Semiconductor Co, and Seoul Viosys Co.,* 2:18-CV-00386-JRG (E. D. Tx. filed: Nov 20th 2018), (retained by defendant Frys Electronics) - Lamkin IP Defense
 - a. Deposition: 0 (Cumulative total: 26),
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: LED chips, LED packaging, LED lenses, LED luminaires, backlights, displays, and televisions/monitors
- 74. Active case work: 2Q2019 – 4Q2019; *Hanwha Q CELLS & Advance Materials Corporation, v. JinkoSolar, LONGi Solar, REC Solar*, ITC 337-TA-1151 (filed: Apr 4th 2019), (“Certain Photovoltaic Cells and Products Containing Same,”), retained by patent owner and plaintiff Hanwha Q CELLS) - Covington and Burling LLP
 - a. Deposition: 2 (Cumulative total: 28)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)

75. Active case work: 2Q2019-3Q2019; *Hanwha Q CELLS & Advance Materials Corporation, v. JinkoSolar and affiliates*, 19-CV-00450 (D. Del. filed: Jan 21st 2018), (retained by patent owner and plaintiff Hanwha Q CELLS) - Covington and Burling LLP
 - a. Deposition: 0 (Cumulative total: 28)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Silicon solar cells and materials analysis of passivation layers
76. Active case work: 2Q2019-2Q2019; *Oyster Optics LLC v. Infinera Inc.*, 2:18-CV-00206 (E. D. Tx filed: May 15th 2018); (retained by plaintiff Oyster Optics LLC) – Russ August & Kabat LLP.
 - a. Deposition: 0 (Cumulative total: 28)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Fiber optic based optoelectronic semiconductor component and transceiver design/operation.
77. Active case work: 2Q2019 – 2Q2019; *Nichia Corporation & Osram Opto Semiconductors Inc., v. Lighting Science Group Corp.*, IPR filing: IPR2019-01259 (PTAB filed Jun 28th 2019); (retained by petitioner Nichia and Osram Opto.) – Shearman and Sterling, LLP
 - a. Deposition: 0 (Cumulative total: 28)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: LED chips, LED packaging and ceramic thermal heat sinking technology.
78. Active case work: 2Q2019 – 3Q2019; *Nichia Corporation v. Lighting Science Group Corp.*, 2:17-CV-08849 (C. D. Ca filed Jul 12th 2017); (retained by defendant Nichia) – Shearman and Sterling, LLP
 - a. Deposition: 0 (Cumulative total: 28)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: LED chips, LED packaging and ceramic thermal heat sinking technology
79. Active case work: 3Q2019-3Q2019; *Applied Optoelectronics Inc v. Class Action Lawsuit*, 4:17-CV-02399 (S. D. Tx filed: Mar 6th 2018); (retained by plaintiff Class Action Lawsuit) – Levi and Korsinsky, LLP
 - a. Deposition: 0 (Cumulative total: 28)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Fiber optic based optoelectronic semiconductor components, transceivers, and sub-systems.
80. Active case work: 3Q2019-3Q2019; *DNA Motor v. Kuen Hwa Traffic Industrial Co.*, 18-CV-05664 (C. D. Ca filed: Jan 15th 2019); (defendant DNA Motor) – Elizabeth Yang, Law and Mediation Office
 - a. Deposition: 0 (Cumulative total: 28)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 9)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: LED design patent, and the design of an aftermarket LED based headlight assembly for an automobile.
81. Active case work: 3Q2019 – 1Q2020; *Nichia Corporation, Osram Opto Semiconductors Inc., Philips Lumileds, GE Consumer Lighting, Cree, and Signify v. Lighting Science Group Corp.*, ITC 337-TA-1168 (filed: Apr 30th 2019), (“Certain Light-Emitting-Diode products, systems, and components thereof (III)”) (retained by respondents Nichia, Osram Optoelectronics, Philips Lumileds, GE Consumer Lighting, Cree Hong Kong., Signify Corp.) – Shearman and Sterling, LLP
 - a. Deposition: 1 (Cumulative total: 29)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 10)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: LED chips, LED packaging and ceramic thermal heat sinking technology (LTCC).
82. Active case work: 4Q2019 – 1Q2020; *Amazon.com Inc, Bed, Bath and Beyond, IKEA, Target, and Walmart Inc., v. Regents of the University of California*, ITC 337-TA-1172 (filed: July 30th 2019), (“Certain Filament Light-Emitting-Diodes and products containing same”) (retained by respondents Amazon.com Inc, Bed, Bath and Beyond, IKEA, Target, and Walmart Inc.) – Morrison and Foerster, LLP
 - a. Deposition: 2 (Cumulative total: 31)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: LED chips, LED packaging and light bulb filaments with transparent sub-mounts.
83. Active case work: 4Q2019 – 4Q2019; *U.D. Electronic Corp., v. Pulse Electronics, Inc.*, IPR2019-00511 (PTAB filed Dec 28th 2018), (retained by petitioner U. D. Electronic Corp.) – Procopio, Cory, Hargreaves and Savitch LLP
 - a. Deposition: 0 (Cumulative total: 31)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)

- d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components.
84. Active case work: 1Q2020 – 2Q2020; *IKEA, v. Regents of the University of California*, ITC 337-TA-1172 (filed: July 30th 2019), (“Certain Filament Light-Emitting-Diodes and products containing same”) (retained by respondents IKEA) – Flaster and Greenberg, LLP
 - a. Deposition: 2 (Cumulative total: 31)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: LED chips, LED packaging and light bulb filaments with transparent sub-mounts.
85. Active case work: 1Q2020-1Q2020; *Hanwha Solutions Corporation, v. Longi Green Energy, Longi Solar Technology, Longi Trading et al.*, IPR2019-01072 (PTAB filed 13th May 2019), (retained by patent owner Hanwha Solutions Corporation) - Covington and Burling LLP
 - a. Deposition: 0 (Cumulative total: 31)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Silicon solar cells and materials analysis of passivation layers
86. Active case work: 1Q2020-1Q2020; *Hanwha Solutions Corporation, v. REC Solar Pte. Ltd. and JinkSolar (U.S.) Inc.* IPR2019-01145 (PTAB filed 6th March 2019), (retained by patent owner Hanwha Solutions Corporation) - Covington and Burling LLP
 - a. Deposition: 0 (Cumulative total: 31)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Silicon solar cells and materials analysis of passivation layers
87. Active case work: 4Q2019 – 2Q2020; *Viavi Solutions Inc., v. Optrontec Inc.*, ITC 337-TA-1187 (filed: 18th November 2019), (“Certain Electronic devices with Optical Filters and Optical Sensor Systems and Components Thereof”) (retained by complainant Viavi Solutions Inc.,) – Venable, LLP
 - a. Deposition: 0 (Cumulative total: 31)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Optical filters and optical sensor systems, design and fabrication of dielectric materials for passband filters in applications such as optical communications, imaging, sensing, medical, automotive.
88. Active case work: 2Q2020 – 4Q2020; *Leviton Manufacturing Co., v. Corning Optical Communications LLC.*, ITC 337-TA-1194 (filed: 19th March 2020), (“Certain High-Density Fiber Optic Equipment and Components Thereof”) (retained by respondent Leviton Manufacturing Co.,) – Morrison & Foerster, LLP
 - a. Deposition: 1 (Cumulative total: 32)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 11)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Fiber optic adapters, fiber optic connectors (simplex, duplex, quad, multi-fiber), fiber trays, racks, and fiber cabinet equipment.
 - e. Technology: LED chips, LED packaging and light bulb filaments with transparent sub-mounts.
89. Active case work: 2Q2020 – 2Q2020; subject to PO/NDA and engagement letter xxx v. yyy, Post Grant Review petition for proceedings (US Patent # zzz), retained by Morrison and Foerster, LLP
 - a. Deposition: 0 (Cumulative total: 31)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 10)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Optoelectronics, LEDs, lead frame packaging, optics, optical lenses, GaN (Gallium Nitride), optical transparency
90. Active case work: 1Q2020-3Q2020; *Collect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.*, IPR2020-00560 (PTAB filed 16th Feb 2020), (retained by patent owner Collect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
 - a. Deposition: 0 (Cumulative total: 32)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 11)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Silicon CMOS image sensors, drive electronics, smart pixels and CCD technology
91. Active case work: 2Q2020-2Q2020; *Panasonic, v. 3M Innovative Properties Company.*, Preparation for IPR filing, (retained by defendant Panasonic) – retained by Westerman Hattori Daniels & Adrian LLP
 - a. Deposition: 0 (Cumulative total: 32)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 11)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 4)
 - d. Technology: Touch sensor (resistive, optical, and capacitive) technology for mobile displays. Analysis of display, electronic, and optical technologies.

92. Active case work: 2Q2020-3Q2020; *Longi Green Energy Technology Co, Longi Solar Technology Co, Long Solar Technology (H.K., Kuching, Taizhou, Zhejiang, Hefei, US) v. Hanwha Solutions Corporation.*, IPR 2019-01072, (retained by patent owner Hanwha Solutions Corporation) – Quinn Emanuel Urquhart & Sullivan, LLP
 - a. Deposition: 1 (Cumulative total: 33)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 11)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 5)
 - d. Optoelectronics; solar cell design, fabrication, device performance, packaging, and interface issues relating to passivation (both chemical and electric field enhanced).
93. Active case work: 3Q2020-3Q2020; *Oyster Optics LLC v. Ciena Corp.*, 4:17-CV-05920 (N. D. CA filed: April 22nd 2020); (retained by plaintiff Oyster Optics LLC) – Russ August & Kabat LLP.
 - a. Deposition: 0 (Cumulative total: 33)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 12)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 5)
 - d. Technology: Fiber optic based optoelectronic semiconductor component design and operation, especially phase shift keying (PSK, QPSK) and phase based coherent communications.
94. Active case work: 3Q2020-2Q2021; *Capella Photonics Inc., v. Infinera Corporation, Tellabs, Tellabs Operations Inc., Coriant American Inc., and Coriant USA Inc.*, 2:20-CV-00077 (E. D. TX filed: March 16th 2020); (retained by defendant Infinera Inc.) – Baker Botts LLP.
 - a. Deposition: 1 (Cumulative total: 34)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 12)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 5)
 - d. Technology: Fiber optic wavelength selective switches (WSS), reconfigurable add-drop multiplexors (ROADMs), and their design. Technical issues include polarization, wavelength selection, coupling, mux/demux and operation in optical networks.
95. Active case work: 3Q2020-3Q2020; *Longi Green Energy Technology Co, Longi Solar Technology Co, Long Solar Technology (H.K., Kuching, Taizhou, Zhejiang, Hefei, US) v. Hanwha Solutions Corporation.*, IPR 2020-00353, (retained by patent owner Hanwha Solutions Corporation) – Quinn Emanuel Urquhart & Sullivan, LLP
 - a. Deposition: 0 (Cumulative total: 34)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 12)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 6)
 - d. Optoelectronics: solar cell design, fabrication, device performance, packaging, and interface issues relating to passivation (both chemical and electric field enhanced).
96. Active case work: 3Q2020-2Q2021; *Appotronics Corporation Ltd. v. Delta Electronics Inc.*, 2:19-CV-00466 (E. D. Va filed: July 22nd 2020); (retained by defendant Delta Corporation Inc) – Pillsbury Winthrop Shaw Pitman LLP.
 - a. Deposition: 1 (Cumulative total: 35)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 12)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Light projectors for display and the color wheel, phosphor technology, high power visible lasers for projection, and the associated packaging of the modules/projectors for efficient cost design..
97. Active case work: 3Q2020 – 2Q2021; *Ideal Industries Lighting LLC (dba Cree Lighting) v. RAB Lighting Inc.*, ITC 337-TA-1213 (filed: 15th July 2020), (“Certain Light-emitting Diode Products, Fixtures, and Components thereof”), (retained by plaintiff Ideal Industries Lighting LLC (dba Cree Lighting) – Quinn Emanuel Urquhart an Sullivan, LLP
 - a. Deposition: 1 (Cumulative total: 36)
 - b. Trial/Hearing/Court appearance: 2 (twice at the stand); (Cumulative total: 14)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Visible GaN based LEDs and various packaging optical lens designs for directing and re-directing LED light output with applications in street lighting.
98. Active case work: 3Q2020-3Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.*, *ex parte* declaration entitled, ‘Hand-held computers incorporating reduced area imaging devices’, for U.S. Patent 6,982,742 (control number 90/014,453), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
 - a. Deposition: 0 (Cumulative total: 36)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.
99. Active case work: 3Q2020-3Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.*, *ex parte* declaration entitled, ‘Communication devices incorporating reduced area imaging devices’, for U.S. Patent 6,452,626 (control number 90/014,455), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
 - a. Deposition: 0 (Cumulative total: 36)

- b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.
- 100. Active case work: 4Q2020-4Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.*, IPR declaration for U.S. Patent 9,198,565 (IPR2020-00476), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
 - a. Deposition: 0 (Cumulative total: 36)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.
- 101. Active case work: 4Q2020-4Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.*, IPR declaration for U.S. Patent 9,667,896 (IPR2020-00477), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
 - a. Deposition: 0 (Cumulative total: 36)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.
- 102. Active case work: 4Q2020 – 1Q2021; *U.D. Electronic Corp., v. Pulse Electronics, Inc.*, 3:18-CV-00373 (Filed Fed 16th 2018), (retained by petitioner U. D. Electronic Corp.) – retained by defendant Perkins Coie LLP.
 - a. Deposition: 1 (Cumulative total: 37)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Electrical and fiber optic connectors, panels, and distribution switches using both electronic and optoelectronic components. Noise suppression using EMI between electrical components and connectors.
- 103. Active case work: 4Q2020-4Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.*, IPR declaration for U.S. Patent 9,186,052 (IPR2020-00512), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
 - a. Deposition: 1 (Cumulative total: 38)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.
- 104. Active case work: 4Q2020-4Q2020; *Cellect LLC, v. Samsung Electronics Co., LTD and Samsung Electronics America, Inc.*, IPR declaration for U.S. Patent 9,186,052 (IPR2020-00475), (retained by patent owner Cellect LLC) – retained by Kramer Levin Naftalis & Frankel LLP
 - a. Deposition: 1 (Cumulative total: 39)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Hand-held silicon CMOS image sensors, drive electronics, smart pixels and CCD technology. Technical history of CCD v. CMOS image sensors in the 1990s and associated performance criteria.
- 105. Active case work: 3Q2020 – 1Q2021; *Huawei Technologies Co. Ltd. v. Verizon Communications, Inc., et al.*, 20-CV-030-JRG (TX E. D. Filed 2^{1st} April 2020), (retained by plaintiff Huawei Technologies Co. Ltd.) – retained by plaintiff Caldwell Cassady Curry P.C.
 - a. Deposition: 0 (Cumulative total: 39)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 14)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Analysis of coding for fiber optic communications, specifically in relation to the standardization process for the Telecommunication Standardization Sector of the International Telecommunications Union (“ITU-T”), including the ITU-T’s G.709: Interfaces for the optical transport network standard (“G.709” or “the G.709 Standard”). In particular, the technical issues that relate to OTN hierarchy; functionality of the overhead in support of multi-wavelength optical networks; frame structures, bit rates, and formats for mapping client signals.
- 106. Active case work: 1Q2021 – 3Q2021; *IKEA et al., v. Regents of the University of California*, ITC 337-TA-1220 (filed: 29th September 2020), (“Certain filament light-emitting diodes and products containing same (II)”), (retained by respondent JDG: IKEA, Global Value Lighting, Signify, Home Depot, GE, Satco) – retained by

Flaster Greenberg PC, Kirkland and Ellis, GT Law, Alston and Bird, Jones Day and Goodwin Law as JDG counsel.

- a. Deposition: 2 (Cumulative total: 41)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 15)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: LED chips, LED packaging and light bulb filaments with transparent sub-mounts.
107. Active case work 4Q2020 – 1Q2021; *Uber Technologies Inc., v. Anthony Scott Levandowski*; Case No. 20-30242 (HLB) and 20-03050 (filed 16th September 2020), retained by defendant Uber Technologies Inc., retained by Jenner and Block LLP.
- a. Deposition: 0 (Cumulative total: 41)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 15)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: LIDAR technology for motor vehicles that includes fiber amplifiers, LIDAR hardware, laser diodes, photodetectors, fiber links, and free space communications.
108. Active case work: 1Q2021 – 3Q2021; *CoSemi Technologies, v. Everpro Technologies, Fibbr Technologies, Logitech, and Facebook Technologies*, ITC 337-TA-1233 (filed: 29th October 2020), “Certain active optical cables and products containing same”, (retained by claimant CoSemi Technologies) – retained by Rutan & Tucker LLP.
- a. Deposition: 1 (Cumulative total: 42)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 15)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Active optical cables with embedded silicon modulator ICs, copper cable, fiber optic cable, VCSEL laser diodes, photodetectors and cable sheathing for consumer applications such as gaming, HDMI, USB, etc.
109. Active case work: 2Q2021 – 3Q2021; *Acuity Brands Lighting ,Inc. v. Heavy Duty Lighting (HDL), LLC.*, 20-CV-03648-SCJ (GA N. D. Filed 2nd September 2020), (retained by defendant Acuity Brands Lighting) – retained by defendant Duane Morris LLP.
- a. Deposition: 1 (Cumulative total: 43)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 15)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: LED lighting, LED chips, LED packages and LED packaging technologies such as molding, glob-top, substrates, die mounting, optical reflectors, and electrical interconnect layouts.
110. Active case work: 2Q2021 – 4Q2021; *Jiaxing Super Lighting Electric Appliance Co., LTD and Obert Inc. v. CH Lighting Technology co., LTD., Elliott Electric Supply Inc., and Shaoxing Ruising Lighting co., Ltd.*, 20-CV-00018-ADA (TX W D. Filed 16th March 2020), (retained by defendant CH Lighting et al) – retained by defendant Holland and Knight LLP.
- a. Deposition: 1 (Cumulative total: 44)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 16)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: LED lighting and LED packaging technologies for T8 and T12 form factor tube lighting. Technologies such as LED luminaire/tube packaging, mechanical structure, thermal heat dissipation, electronic circuitry, printed circuit boards, and LED chips.
111. Active case work: 3Q2021 – 1Q2022; *ASUSTEK Computer Inc, v. KT Imaging USA LLC*, 20-CV-00300-ADA (TX W D. Filed 20th April 2020, (retained by defendant ASUSTEK Computer Inc) – retained by defendant Turner Boyd LLP.
- a. Deposition: 0 (Cumulative total: 44)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 16)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Image sensor modules, cameras in PCs/laptops, consumer products, tear downs, optical lenses, optical packaging, optical alignment.
112. Active case work: 3Q2021 – 3Q2021; *Jiaxing Super Lighting Electric Appliance Co., LTD and Obert Inc. v. Maxlite Inc.*, 19-CV-04047 (CA C.D. Filed 8th May 2019), (retained by defendant Maxlite Inc) – retained by defendant Holland and Knight LLP.
- a. Deposition: 0 (Cumulative total: 44)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 16)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: LED lighting and LED packaging technologies for T8 and T12 form factor tube lighting. Technologies such as LED luminaire/tube packaging, mechanical structure, thermal heat dissipation, electronic circuitry, printed circuit boards, and LED chips.
113. Active case work: 3Q2021 – 1Q2023; *Feit Electric Company Inc., v. Nichia Corporation*, 20-CV-00359-GW, (CA C. D. Filed 13th January 2020), (retained by defendant Feit Electric Company) – retained by Benesch Friedlander Coplan & Aronoff LLP
- a. Deposition: 2 (Cumulative total: 46)
 - b. Trial/Hearing/Court appearance: 2 (Cumulative total: 18)

- c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: LED lighting, LED chips, LED packages and LED packaging technologies such as lead-frames, molding, glob-top, substrates, die mounting, optical reflectors, and electrical interconnect layouts.
- 114. Active case work: 2Q2021 – 2Q2022; *Samsung Corporation vs TBD*, Pre-patent litigation, (retained by plaintiff Samsung Corporation), - retained by Quinn Emanuel Urquhart & Sullivan, LLP).
 - a. Deposition: 0 (Cumulative total: 46)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: TV displays, OLEDs, LCDs, color gamut, and quality of RGB/white color as per CIE charts and colorimetry (NTSC, sRGB, AdobeRGB etc.,). Analysis of CHL (constant hue locus), quantum dots, nano-crystals, nano-devices, nano-structures to improve light quality output.
- 115. Active case work 2Q2021 – 2Q2021, *Holochip Corporation v. Edmund Optics, Optotune AG and others TBD*, Pre-patent litigation for ITC, (retained by plaintiff Holochip Corporation), - retained by King and Spalding LLP).
 - a. Deposition: 0 (Cumulative total: 46)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 6)
 - d. Technology: Fluid lenses, and optical lenses with controlled focus facilities. Packaging of fluid lenses using piezoelectric actuators, and hermetic chambers. Deformable surfaces using micro-fluidics.
- 116. Active case work: 2Q2021-3Q2021; *Home Depot USA Inc., v. Lynk Labs, Inc.*, IPR declaration for U.S. Patent 10,757,783 (IPR2021-01368), (retained by petitioner Home Depot USA, Inc) – retained by DLA Piper LLP
 - a. Deposition: 1 (Cumulative total: 47)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 7)
 - d. Technology: LED products, LED circuits, including both DC and AC circuit design. LED color emission, white light, color mixing, CIE charts, and black body radiators for color temperature.
- 117. Active case work: 2Q2021-3Q2021; *Home Depot USA Inc., v. Lynk Labs, Inc.*, IPR declaration for U.S. Patent 10,492,251 (IPR2021-01369), (retained by petitioner Home Depot USA, Inc) – retained by DLA Piper LLP
 - a. Deposition: 1 (Cumulative total: 48)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 8)
 - d. Technology: LED products, LED circuits, including both DC and AC circuit design. LED color emission, white light, color mixing, CIE charts, and black body radiators for color temperature.
- 118. Active case work: 3Q2021-3Q2021; *Home Depot USA Inc., v. Lynk Labs, Inc.*, IPR declaration for U.S. Patent 10,091,842 (IPR2021-01540), (retained by petitioner Home Depot USA, Inc) – retained by DLA Piper LLP
 - a. Deposition: 1 (Cumulative total: 49)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 9)
 - d. Technology: LED products, LED circuits, including both DC and AC circuit design. LED color emission, white light, color mixing, CIE charts, and black body radiators for color temperature.
- 119. Active case work: 4Q2021-4Q2021; *Home Depot USA Inc., v. Lynk Labs, Inc.*, IPR declaration for U.S. Patent 10,517,149 (IPR2022-000023), (retained by petitioner Home Depot USA, Inc) – retained by DLA Piper LLP
 - a. Deposition: 1 (Cumulative total: 50)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 10)
 - d. Technology: LED products, LED circuits, including both DC and AC circuit design. LED color emission, white light, color mixing, CIE charts, and black body radiators for color temperature.
- 120. Active case work: 4Q2021-Present; *Everlight Elecs. Co. Ltd. v. Amazon.com, Inc. et al.*, 6:21-CV-00906 (W. D. TX filed: August 31st 2021); (retained by defendant Amazon.com) – Morrison and Foerster LLP.
 - a. Deposition: 0 (Cumulative total: 50)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 18)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 10)
 - d. Technology: LED chips, LED packaging with metallic electrodes, flip-chip solder bumping, and doping of semiconductors for electrical conduction.
- 121. Active case work: 4Q2021-2Q2021; *Hanwha Solutions Corporation and affiliated companies including Q-Cells, Boviet Renewable Power, Boviet Solar, Canadian Solar International v. Advanced Silicon Group Technologies*, ITC 337-TA-1271 (filed: 14th October 2020) “Certain silicon photovoltaic cells and modules with nanostructures, and products containing the same.” (retained by joint defense group consisting of Quinn Emanuel Urquhart & Sullivan, LLP., Morgan Lewis and Bockius, LLP., and Sidley Austin LLP.).
 - a. Deposition: 2 (Cumulative total: 52)
 - b. Trial/Hearing/Court appearance: 1 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 10)

- d. Technology: Silicon based solar/photovoltaic cells and modules that include fabrication techniques such as deposition, diffusion, wet/dry etching of nanostructures, nanowires, and nano-structures, nano-features, black silicon, monocrystalline wafers, and polysilicon fabrication.
122. Active case work: 4Q2021-2Q2022; *Dell Computer Inc. v. KT Imaging USA LLC*, Declaration for IPR with patent number 6,876,544 as petitioner, (to be filed), (retained by defendant Dell Computer Inc) – retained by petitioner Farella, Braun, and Martel.
 - a. Deposition: 0 (Cumulative total: 52)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 10)
 - d. Technology: Image sensor modules, cameras in PCs/laptops, consumer products, tear downs, optical lenses, optical packaging, optical alignment.
123. Active case work: 1Q2022-2Q2022; *Cree Lighting, Wolfspeed, Ideal Industries Lighting, v. CAO Lighting*, Declaration for IPR with patent number 6,465,961 as petitioner, (filed 8th April 2022), (retained by defendant Cree Lighting) – retained by Kilpatrick Townsend & Stockton LLP.
 - a. Deposition: 2 (Cumulative total: 54)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 2 (Cumulative total: 12)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, active regions, cladding layers, optical mirrors, DBRs
124. Active case work: 1Q2022-2Q2022; *Cree Lighting, Wolfspeed, Ideal Industries Lighting, v. CAO Lighting*, Declaration for IPR with patent numbers 6,634,770 as petitioner, (filed 8th April 2022), (retained by defendant Cree Lighting) – retained by Kilpatrick Townsend & Stockton LLP.
 - a. Deposition: 1 (Cumulative total: 55)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 13)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, active regions, cladding layers, optical mirrors, DBRs
125. Active case work: 1Q2022-2Q2022; *Cree Lighting dba Ideal Industries Lighting, v. CAO Lighting*, 1:21-cv-00634 (MD NC filed 12th Aug 2021,), (retained by defendant Cree Lighting) – retained by Kilpatrick Townsend & Stockton LLP.
 - a. Deposition: 0 (Cumulative total: 55)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 13)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, active regions, cladding layers, optical mirrors, DBRs
126. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi)*, 6:21-cv-00322 (WD Tex filed 12th Aug 2021,), (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
 - a. Deposition: 0 (Cumulative total: 55)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 13)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding layers, optical mirrors, DBRs
127. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi)*, Declaration for IPR (IPR2022-00395) as patent owner, (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
 - a. Deposition: 2 (Cumulative total: 57)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 2 (Cumulative total: 15)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding layers, optical mirrors, DBRs
128. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi)*, Declaration for IPR (IPR2022-00396) as patent owner, (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
 - a. Deposition: 0 (Cumulative total: 57)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)

- d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding layers, optical mirrors, DBRs
129. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi)*, Declaration for IPR (IPR2022-00397) as patent owner, (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
 - a. Deposition: 0 (Cumulative total: 57)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding layers, optical mirrors, DBRs
 130. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi)*, Declaration for IPR (IPR2022-00406) as patent owner, (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
 - a. Deposition: 0 (Cumulative total: 57)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 15)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding layers, optical mirrors, DBRs
 131. Active case work: 1Q2022-2Q2022; *Lite-On Technology Corporation and Genesis Photonics Inc., v. Sensor Electronic Technology Inc., (SETi)*, Declaration for IPR (IPR2022-00419) as patent owner, (retained by plaintiff LiteOn and Genesis) – retained by Pillsbury Winthrop Shaw Pittman LLP.
 - a. Deposition: 1 (Cumulative total: 58)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 1 (Cumulative total: 16)
 - d. Technology: LED based light bulbs, LED chips, LED arrays, LED packaging, flip-chip packaging, chip-on-board, heat sinks, GaN, InGaN, AlGaN (Gallium Nitride, Indium Gallium Nitride, Aluminum Gallium Nitride) epitaxial layers, GaN fabrication, LED quantum well active regions, LED cladding layers, optical mirrors, DBRs
 132. Active case work: 1Q2022-3Q2022; *Panasonic Corporation, v. Magna International Inc.*, 21-cv-00319 (WD Tex filed 31st Mar 2021.), (retained by plaintiff Panasonic) – retained by Sidley Austin LLP.
 - a. Deposition: 0 (Cumulative total: 58)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Automotive sensors, cameras, electronic circuitry, controls, packaging, surround view camera systems.
 133. Active case work: 2Q2022 – Present; *Jiaxing Super Lighting Electric Appliance Co., LTD and Obert Inc. v. Maxlite Inc.*, 19-CV-04047 (CA C.D. Filed 8th May 2019), (retained by defendant Maxlite Inc) – retained by defendant Procopio, Cory, Hargreaves and Savitch LLP.
 - a. Deposition: 0 (Cumulative total: 58)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: LED lighting and LED packaging technologies for T8 and T12 form factor tube lighting. Technologies such as LED luminaire/tube packaging, mechanical structure, thermal heat dissipation, electronic circuitry, printed circuit boards, and LED chips.
 134. Active case work: 1Q2022 – 4Q2022; *Advanced Engineering Services LLC., v. Lumasense Technologies Inc., and DOES 1-50*, 21-CV-03279-WHO combined with 20-CV-07905-WHO (CA N.D. Filed 23rd Feb 2022), (retained by plaintiff Advanced Engineering Services LLC) – retained by plaintiff SAC Attorneys LLP
 - a. Deposition: 1 (Cumulative total: 59)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Thermal, gas, and flow sensing for use in designing and manufacturing equipment used in semiconductor chip manufacturing. In particular, review of data relating to the simulation of finite element analysis (“FEA”) and computational fluid dynamics (“CFD”) data for gases, temperature, and stress with actual sensor data that could be intelligently integrated, customized, installed, tested, verified, and validated.
 135. Active case work: 2Q2022-3Q2022; *Frontier Communications v. Charter Communications*, Pre-litigation IP and Due Diligence; Case No. TBD; Retained by Frontier Communications, (retained by Mayer Brown LLP)
 - a. Deposition: 0 (Cumulative total: 59)

- b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Optical PON for high-speed data FTTH evaluation, testing, and analysis.
- 136. Active case work: 2Q2022-3Q2022; *Russ, August & Kabat*, Pre-litigation IP and Due Diligence; Case No. TBD; (retained by plaintiff – Russ, August & Kabat LLP)
 - a. Deposition: 0 (Cumulative total: 59)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: High volume fiber optic transceivers for EPON/GPON with: CDR circuits, ‘Intelligence-in-the-Module’ and ‘M-ary’ families.
- 137. Active case work: 2Q2022-3Q2022; *Signify Holding B.V. v. GE Lighting Solutions LLC.*, Declaration for IPR (IPR2022-XXX – in draft form for US patent #7,497,973) as petitioner, (retained by petitioner Signify Holding B.V.) – retained by Alston and Bird LLP
 - a. Deposition: 0 (Cumulative total: 59)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: LED based light bulbs, LED chips that emit in the UV and visible, LED arrays, LED packaging including phosphors and encapsulants, and the type of phosphors utilized for different emission. In particular, phosphors that are activated by dopants such as Europium (Eu), Manganese (Mn) and the associated ions for these materials e.g. Mn²⁺, Mn³⁺, Mn⁴⁺, Mn⁶⁺, etc. Included analysis of InGa^N and AlGa^N based epitaxial material systems, and the use of phosphors in high pressure mercury vapor lamps.
- 138. Active case work: 3Q22 – Present; *Canon, Inc., and Canon USA Inc v. WSOU Investments, LLC d/b/a Brazos Licensing and Development.*, Declaration for IPR ((IPR2022-XXX) for US patent #7,493,030 as petitioner, (retained by Canon Inc) – retained by Orrick LLP
 - a. Deposition: 0 (Cumulative total: 59)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Digital camera operation including optical focus, image sensing, optical train, depth of field, exposure time, different focus and focal areas of a portion of the image, general photography and optical principles.
- 139. Active case work: 3Q22 – Present; *Canon, Inc., and Canon USA Inc v. WSOU Investments, LLC d/b/a Brazos Licensing and Development.*, 21-CV- 00166-ADA-DTG (W.D. TX.) Filed 29th Sept 2022. (retained by defendant Canon Inc) – retained by Orrick LLP
 - a. Deposition: 1 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Digital camera operation including optical focus, image sensing, optical train, depth of field, exposure time, different focus and focal areas of a portion of the image, general photography and optical principles.
 - e.
- 140. Active case work: 3Q22 – Present; *Fujifilm Sonosite., v. Butterfly Network, Inc.*, 1-22-CV-00309 (D.Del) Filed 29th Mar 2022), (retained by defendant Butterfly Network, Inc.) – retained by defendant Akin Gump LLP
 - a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: Ultra-sonic equipment that includes displays, especially OLED displays. The electronic circuits and how displays are electronically controlled.
- 141. Active case work: 3Q22 – Present; *LedComm LLC., v. IKEA US Retail LLC et al*, 6-22-CV-00302-ADA (W.D. Tx.) Filed 21st Mar 2022), (retained by defendant IKEA US Retail LLC et al.) – retained by defendant Flaster Greenberg LLP
 - a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: LED surface mount packaging, LED GaN/InGa^N chips, and associated LED lighting performance specifications.
- 142. Active case work: 2Q22 – 3Q2022; *NXP Semiconductors N.V. and NXP USA Inc., v. MediaTek Inc., Amazon.com Inc., Belkin International Inc, Linksys USA Inc., et al*, ITC Investigation 337-TA-1287 entitled “Certain integrated circuits, and electronic devices and products containing the same” (Filed 1st Dec 2021), (retained by respondents Amazon.com Inc.,) – retained by respondent Morrison Foerster LLP
 - a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)

- d. Technology: LED surface mount packaging, LED GaN/InGaN chips, and associated LED lighting performance specifications. LED Luminaires.
143. Active case work: 3Q22 – 4Q22; *Amazon.com Inc., v. Epistar Corp.*, 6-22-CV-00526-ADA (W.D. Tx.) Filed 24th May 2022), (retained by defendant Amazon.com Inc..) – retained by defendant Morrison Foerster LLP
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: LED surface mount packaging, LED GaN/InGaN chips, GaN/InGaN epitaxial growth, fabrication, device design and packaging. LED luminaires.
144. Active case work: 4Q22 – Present; *Amazon.com Inc., v. Epistar Corp.*, 6-22-CV-00526-ADA (W.D. Tx.) Filed 24th May 2022), (retained by defendant Amazon.com Inc..) – retained by defendant Perkins Coie LLP
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: LED surface mount packaging, LED GaN/InGaN chips, GaN/InGaN epitaxial growth, fabrication, device design and packaging. LED Luminaires.
145. Active case work: 4Q22 – Present; *Qorvo, v. Akoustis Technologies Inc.*, 1-21-CV-1417-JPM (C.A.) Filed 4th Oct 2021), (retained by defendant Akoustis.) – retained by defendant Pillsbury LLP
- a. Deposition: 0 (Cumulative total: 60)
 - b. Trial/Hearing/Court appearance: 0 (Cumulative total: 19)
 - c. IPR/PTAB trial/deposition: 0 (Cumulative total: 16)
 - d. Technology: acoustic wave filters, BAW filters (bulk-acoustic-wave) filters for RF applications, devices, fabrication, and characterization
 - e.

ISSUED utility PATENTS and PUBLISHED PATAENT APPLICATIONS ISSUED:

Current combined total = 335

1	US-11614670-B2	Preview	PDF	Electro-optic polymer devices having high performance claddings, and methods of preparing the same	Yi; Youngwoo et al.	2023-03-28	21
2	US-11520175-B2	Preview	PDF	Active region-less modulator and method	Lebby; Michael et al.	2022-12-06	62
3	US-11506918-B2	Preview	PDF	Hybrid EO polymer modulator with ALD sealant layer	Lebby; Michael et al.	2022-11-22	18
4	US-11495670-B2	Preview	PDF	Integrated epitaxial metal electrodes	Pelzel; Rodney et al.	2022-11-08	25
5	US-11435603-B2	Preview	PDF	TFP optical transition device and method	Leonberger; Frederick J. et al.	2022-09-06	32
6	US-11435604-B2	Preview	PDF	Hybrid EO polymer modulator with silicon photonics	Lebby; Michael et al.	2022-09-06	21
7	US-20220246822-A1	Preview	PDF	Josephson Junction using Molecular Beam Epitaxy	Lebby; Michael S. et al.	2022-08-04	10
8	US-20220187638-A1	Preview	PDF	HYBRID EO POLYMER MODULATOR WITH ALD SEALANT LAYER	Lebby; Michael et al.	2022-06-16	18
9	US-20220187637-A1	Preview	PDF	HYBRID EO POLYMER MODULATOR WITH SILICON PHOTONICS	Lebby; Michael et al.	2022-06-16	22
10	US-20220113566-A1	Preview	PDF	TFP OPTICAL TRANSITION DEVICE AND METHOD	Leonberger; Frederick J. et al.	2022-04-14	32
11	US-11262605-B2	Preview	PDF	Active region-less polymer modulator integrated on a common PIC platform and method	Lebby; Michael et al.	2022-03-01	32
12	US-20220052249-A1	Preview	PDF	A-axis Josephson Junctions with Improved Smoothness	Lebby; Michael S. et al.	2022-02-17	40

13	US-11201278-B2	Preview	PDF Josephson Junction using molecular beam epitaxy	Lebby; Michael S. et al.	2021-12-14	10
14	US-11201451-B2	Preview	PDF Porous distributed Bragg reflectors for laser applications	Hammond; Rich et al.	2021-12-14	20
15	US-11067748-B2	Preview	PDF Guide transition device and method	Lebby; Michael et al.	2021-07-20	24
16	US-11063114-B2	Preview	PDF III-N to rare earth transition in a semiconductor structure	Dargis; Rytis et al.	2021-07-13	23
17	US-11042051-B2	Preview	PDF Direct drive region-less polymer modulator methods of fabricating and materials therefor	Lebby; Michael et al.	2021-06-22	25
18	US-20210141251-A1	Preview	PDF ACTIVE REGION-LESS MODULATOR AND METHOD	Lebby; Michael et al.	2021-05-13	63
19	US-20210141250-A1	Preview	PDF ACTIVE REGION-LESS MODULATOR AND METHOD	Lebby; Michael et al.	2021-05-13	29
20	US-10989871-B2	Preview	PDF Protection layers for polymer modulators/waveguides	Becker; Richard et al.	2021-04-27	12
21	US-20210005720-A1	Preview	PDF ELECTRONIC DEVICE WITH 2-DIMENSIONAL ELECTRON GAS BETWEEN POLAR-ORIENTED RARE-EARTH OXIDE LAYER GROWN OVER A SEMICONDUCTOR	Dargis; Rytis et al.	2021-01-07	23
22	US-10886694-B2	Preview	PDF Hermetic capsule and method	Lebby; Michael	2021-01-05	17
23	US-10825912-B2	Preview	PDF Integrated epitaxial metal electrodes	Pelzel; Rodney et al.	2020-11-03	20
24	US-20200285085-A1	Preview	PDF DIRECT DRIVE REGION-LESS POLYMER MODULATOR METHODS OF FABRICATING AND MATERIALS THEREFOR	Lebby; Michael et al.	2020-09-10	25
25	US-10754093-B2	Preview	PDF Fabrication process of polymer based photonic apparatus and the apparatus	Liu; Zhiming et al.	2020-08-25	12
26	US-20200183201-A1	Preview	PDF ACTIVE REGION-LESS POLYMER MODULATOR INTEGRATED ON A COMMON PIC PLATFORM AND METHOD	Lebby; Michael et al.	2020-06-11	31

27 US-20200183245-A1	Preview	PDF ELECTRO-OPTIC POLYMER DEVICES HAVING HIGH PERFORMANCE CLADDINGS, AND METHODS OF PREPARING THE SAME	Yi; Youngwoo et al.	2020-06-11	21
28 US-20200161417-A1	Preview	PDF III-N TO RARE EARTH TRANSITION IN A SEMICONDUCTOR STRUCTURE	Dargis; Rytis et al.	2020-05-21	20
29 US-20200150363-A1	Preview	PDF CONDUCTIVE MULTI-FIBER/PORT HERMETIC CAPSULE AND METHOD	Lebby; Michael	2020-05-14	27
30 US-20200119516-A1	Preview	PDF HERMETIC CAPSULE AND METHOD	Lebby; Michael	2020-04-16	16
31 US-10615141-B2	Preview	PDF Pnictide buffer structures and devices for GaN base applications	Clark; Andrew et al.	2020-04-07	16
32 US-10605987-B2	Preview	PDF Re-based integrated photonic and electronic layered structures	Clark; Andrew et al.	2020-03-31	42
33 US-20200091398-A1	Preview	PDF JOSEPHSON JUNCTION USING MOLECULAR BEAM EPITAXY	Lebby; Michael S. et al.	2020-03-19	10
34 US-20200088939-A1	Preview	PDF GUIDE TRANSITION DEVICE AND METHOD	Lebby; Michael et al.	2020-03-19	23
35 US-20200088941-A1	Preview	PDF PROTECTION LAYERS FOR POLYMER MODULATORS/WAVEGUIDES	Becker; Richard et al.	2020-03-19	12
36 US-10591755-B2	Preview	PDF Direct-drive polymer modulator methods of fabricating and materials therefor	Becker; Richard et al.	2020-03-17	20
37 US-20200083668-A1	Preview	PDF GUIDE TRANSITION DEVICE WITH DIGITAL GRATING DEFLECTORS AND METHOD	Lebby; Michael et al.	2020-03-12	15
38 US-10573686-B2	Preview	PDF Epitaxial AlN/cREO structure for RF filter applications	Wang; Wang Nang et al.	2020-02-25	19
39 US-10574025-B2	Preview	PDF Hermetic capsule and method for a monolithic photonic integrated circuit	Lebby; Michael	2020-02-25	17
40 US-10566944-B2	Preview	PDF Layer structures for RF filters fabricated using rare earth oxides and epitaxial aluminum nitride	Pelzel; Rodney et al.	2020-02-18	28

41	US-10527786-B2	Preview	PDF Polymer modulator and laser integrated on a common platform and method	Leonberger; Frederick J et al.	2020-01-07	27
42	US-10520673-B2	Preview	PDF Protection layers for polymer modulators/waveguides	Becker; Richard et al.	2019-12-31	12
43	US-10509164-B2	Preview	PDF Guide transition device and method	Lebby; Michael et al.	2019-12-17	23
44	US-10511146-B2	Preview	PDF Guide transition device with digital grating deflectors and method	Lebby; Michael et al.	2019-12-17	16
45	US-20190353843-A1	Preview	PDF FABRICATION PROCESS OF POLYMER BASED PHOTONIC APPARATUS AND THE APPARTUS	Liu; Zhiming et al.	2019-11-21	12
46	US-20190305039-A1	Preview	PDF EPITAXIAL AIN/cREO STRUCTURE FOR RF FILTER APPLICATIONS	Wang; Wang Nang et al.	2019-10-03	18
47	US-10431729-B2	Preview	PDF Josephson junction using molecular beam epitaxy	Lebby; Michael S. et al.	2019-10-01	10
48	US-20190278036-A1	Preview	PDF EMBEDDED HERMETIC CAPSULE AND METHOD	Lebby; Michael	2019-09-12	22
49	US-20190237930-A1	Preview	PDF HERMETIC CAPSULE AND METHOD	Lebby; Michael	2019-08-01	17
50	US-20190227233-A1	Preview	PDF RE-based Integrated Photonic and Electronic Layered Structures	Clark; Andrew et al.	2019-07-25	41
51	US-20190221993-A1	Preview	PDF POROUS DISTRIBUTED BRAGG REFLECTORS FOR LASER APPLICATIONS	Hammond; Rich et al.	2019-07-18	19
52	US-20190204506-A1	Preview	PDF PROTECTION LAYERS FOR POLYMER MODULATORS/WAVEGUIDES	Becker; Richard et al.	2019-07-04	12
53	US-10332857-B2	Preview	PDF Rare earth pnictides for strain management	Clark; Andrew et al.	2019-06-25	30
54	US-20190172923-A1	Preview	PDF Integrated Epitaxial Metal Electrodes	Pelzel; Rodney et al.	2019-06-06	24
55	US-20190148913-A1	Preview	PDF GUIDE TRANSITION DEVICE WITH DIGITAL GRATING DEFLECTORS AND METHOD	Lebby; Michael et al.	2019-05-16	16

56	US-20190139761-A1	Preview	PDF	Prnctide Buffer Structures and Devices for GaN Base Applications	Clark; Andrew et al.	2019-05-09	15
57	US-20190122885-A1	Preview	PDF	GROUP III SEMICONDUCTOR EPITAXY FORMED ON SILICON VIA SINGLE CRYSTAL REN AND REO BUFFER LAYERS	Dargis; Rytis et al.	2019-04-25	13
58	US-20190079243-A1	Preview	PDF	GUIDE TRANSITION DEVICE AND METHOD	Lebby; Michael et al.	2019-03-14	24
59	US-20190074365-A1	Preview	PDF	Integrated Epitaxial Metal Electrodes	Pelzel; Rodney et al.	2019-03-07	20
60	US-20190064436-A1	Preview	PDF	POLYMER MODULATOR AND LASER INTEGRATED ON A COMMON PLATFORM AND METHOD	Leonberger; Frederick J et al.	2019-02-28	26
61	US-20190028081-A1	Preview	PDF	LAYER STRUCTURES FOR RF FILTERS FABRICATED USING RARE EARTH OXIDES AND EPITAXIAL ALUMINUM NITRIDE	Pelzel; Rodney et al.	2019-01-24	28
62	US-10162111-B1	Preview	PDF	Multi-fiber/port hermetic capsule sealed by metallization and method	Lebby; Michael	2018-12-25	34
63	US-10128350-B2	Preview	PDF	Integrated epitaxial metal electrodes	Pelzel; Rodney et al.	2018-11-13	20
64	US-20180259798-A1	Preview	PDF	DIRECT-DRIVE POLYMER MODULATOR METHODS OF FABRICATING AND MATERIALS THEREFOR	Becker; Richard et al.	2018-09-13	20
65	US-10075143-B2	Preview	PDF	Layer structures for RF filters fabricated using rare earth oxides and epitaxial aluminum nitride	Pelzel; Rodney et al.	2018-09-11	29
66	US-20180138284-A1	Preview	PDF	Integrated Epitaxial Metal Electrodes	Pelzel; Rodney et al.	2018-05-17	19
67	US-20180012858-A1	Preview	PDF	RARE EARTH INTERLAYS FOR MECHANICALLY LAYERING DISSIMILAR SEMICONDUCTOR WAFERS	Clark; Andrew et al.	2018-01-11	15
68	US-20180013053-A1	Preview	PDF	Josephson Junction using Molecular Beam Epitaxy	Lebby; Michael S. et al.	2018-01-11	10
69	US-20170353002-A1	Preview	PDF	Rare Earth Pnictides for Strain Management	Clark; Andrew et al.	2017-12-07	29
70	US-20170141750-A1	Preview	PDF	LAYER STRUCTURES FOR RF FILTERS FABRICATED USING RARE EARTH OXIDES AND EPITAXIAL ALUMINUM NITRIDE	Pelzel; Rodney et al.	2017-05-18	29
71	US-9496132-B2	Preview	PDF	Nucleation of III-N on REO templates	Arkun; Erdem et al.	2016-11-15	9
72	US-9443939-B2	Preview	PDF	Strain compensated REO buffer for III-N on silicon	Dargis; Rytis et al.	2016-09-13	7
73	US-20160133708-A1	Preview	PDF	STRAIN COMPENSATED REO BUFFER FOR III-N ON SILICON	Dargis; Rytis et al.	2016-05-12	7
74	US-9236249-B2	Preview	PDF	III-N material grown on REN epitaxial buffer on Si substrate	Dargis; Rytis et al.	2016-01-12	9

75	US-9105471-B2	Preview PDF	Rare earth oxy-nitride buffered III-N on silicon	Clark; Andrew et al.	2015-08-11	7
76	US-20150014676-A1	Preview PDF	III-N MATERIAL GROWN ON REN EPITAXIAL BUFFER ON SI SUBSTRATE	Dargis; Rytis et al.	2015-01-15	10
77	US-20140357014-A1	Preview PDF	HIGH EFFICIENCY SOLAR CELL USING IIIB MATERIAL TRANSITION LAYERS	LEBBY; MICHAEL et al.	2014-12-04	10
78	US-8889978-B2	Preview PDF	III-V semiconductor interface with graded GeSn on silicon	Roucka; Radek et al.	2014-11-18	12
79	US-8878188-B2	Preview PDF	REO gate dielectric for III-N device on Si substrate	Dargis; Rytis et al.	2014-11-04	8
80	US-8872308-B2	Preview PDF	AlN cap grown on GaN/REO/silicon substrate structure	Arkun; Erdem et al.	2014-10-28	5
81	US-8835955-B2	Preview PDF	III-O.sub.xN.sub.y on single crystal SOI substrate and III n growth platform	Arkun; Erdem et al.	2014-09-16	10
82	US-8823055-B2	Preview PDF	REO/ALO/A1N template for III-N material growth on silicon	Arkun; Erdem et al.	2014-09-02	7
83	US-8823025-B1	Preview PDF	III-N material grown on AlO/AlN buffer on Si substrate	Arkun; Erdem et al.	2014-09-02	5
84	US-20140239307-A1	Preview PDF	REO GATE DIELECTRIC FOR III-N DEVICE ON SI SUBSTRATE	DARGIS; RYTIS et al.	2014-08-28	8
85	US-20140231817-A1	Preview PDF	III-N MATERIAL GROWN ON ALO/ALN BUFFER ON SI SUBSTRATE	Arkun; Erdem et al.	2014-08-21	5
86	US-20140231818-A1	Preview PDF	AlN CAP GROWN ON GaN/REO/SILICON SUBSTRATE STRUCTURE	Arkun; Erdem et al.	2014-08-21	5
87	US-20140225123-A1	Preview PDF	REO/ALO/A1N TEMPLATE FOR III-N MATERIAL GROWTH ON SILICON	Arkun; Erdem et al.	2014-08-14	10
88	US-8794010-B2	Preview PDF	Laser cooling of modified SOI wafer	Williams; David L. et al.	2014-08-05	12
89	US-20140167057-A1	Preview PDF	REO/ALO/A1N TEMPLATE FOR III-N MATERIAL GROWTH ON SILICON	Arkun; Erdem et al.	2014-06-19	7
90	US-8748900-B1	Preview PDF	Re-silicide gate electrode for III-N device on Si substrate	Dargis; Rytis et al.	2014-06-10	10
91	US-8680507-B1	Preview PDF	AlN inter-layers in III-N material grown on DBR/silicon substrate	Arkun; Erdem et al.	2014-03-25	6
92	US-20140076390-A1	Preview PDF	III-V SEMICONDUCTOR INTERFACE WITH GRADED GeSn ON SILICON	Roucka; Radek et al.	2014-03-20	13
93	US-20140077240-A1	Preview PDF	IV MATERIAL PHOTONIC DEVICE ON DBR	Roucka; Radek et al.	2014-03-20	5

94	US-20140077338-A1	Preview PDF	Si-Ge-Sn ON REO TEMPLATE	Roucka; Radek et al.	2014-03-20	5
95	US-20140077339-A1	Preview PDF	DELTA DOPING AT Si-Ge INTERFACE	Roucka; Radek et al.	2014-03-20	5
96	US-20140053894-A1	Preview PDF	GRADED GeSn ON SILICON	Roucka; Radek et al.	2014-02-27	13
97	US-8637763-B2	Preview PDF	Solar cells with engineered spectral conversion	Lebby; Michael et al.	2014-01-28	18
98	US-8636844-B1	Preview PDF	Oxygen engineered single-crystal REO template	Dargis; Rytis et al.	2014-01-28	10
99	US-8633569-B1	Preview PDF	AlN inter-layers in III-N material grown on REO/silicon substrate	Arkun; Erdem et al.	2014-01-21	5
100	US-20140008644-A1	Preview PDF	OXYGEN ENGINEERED SINGLE-CRYSTAL REO TEMPLATE	Dargis; Rytis et al.	2014-01-09	10
101	US-8623747-B1	Preview PDF	Silicon, aluminum oxide, aluminum nitride template for optoelectronic and power devices	Arkun; Erdem et al.	2014-01-07	6
102	US-20130334536-A1	Preview PDF	SINGLE-CRYSTAL REO BUFFER ON AMORPHOUS SiO _x	Dargis; Rytis et al.	2013-12-19	7
103	US-8559097-B2	Preview PDF	Integrated pump laser and rare earth waveguide amplifier	Williams; David L. et al.	2013-10-15	10
104	US-8553741-B2	Preview PDF	Integrated rare earth devices	Lebby; Michael	2013-10-08	9
105	US-20130248853-A1	Preview PDF	NUCLEATION OF III-N ON REO TEMPLATES	Arkun; Erdem et al.	2013-09-26	8
106	US-8542437-B1	Preview PDF	Earth abundant photonic structures	Lebby; Michael S. et al.	2013-09-24	21
107	US-20130214282-A1	Preview PDF	III-N ON SILICON USING NANO STRUCTURED INTERFACE LAYER	Arkun; Erdem et al.	2013-08-22	7
108	US-8501635-B1	Preview PDF	Modification of REO by subsequent III-N EPI process	Clark; Andrew et al.	2013-08-06	10
109	US-20130153918-A1	Preview PDF	REO-Si TEMPLATE WITH INTEGRATED REO LAYERS FOR LIGHT EMISSION	Clark; Andrew et al.	2013-06-20	9
110	US-8455756-B2	Preview PDF	High efficiency solar cell using IIIB material transition layers	Lebby; Michael et al.	2013-06-04	10
111	US-20130099357-A1	Preview PDF	STRAIN COMPENSATED REO BUFFER FOR III-N ON SILICON	Dargis; Rytis et al.	2013-04-25	7
112	US-20130071960-A1	Preview PDF	INTEGRATED RARE EARTH DEVICES	LEBBY; MICHAEL	2013-03-21	10

113	US-20130062609-A1	Preview	PDF III-N FET ON SILICON USING FIELD SUPPRESSING REO	Smith; Robin et al.	2013-03-14	10
114	US-20130062610-A1	Preview	PDF LATTICE MATCHED CRYSTALLINE REFLECTOR	Clark; Andrew et al.	2013-03-14	11
115	US-8394194-B1	Preview	PDF Single crystal reo buffer on amorphous SiO.sub.x	Dargis; Rytis et al.	2013-03-12	7
116	US-20130032858-A1	Preview	PDF RARE EARTH OXY-NITRIDE BUFFERED III-N ON SILICON	Clark; Andrew et al.	2013-02-07	8
117	US-8331410-B2	Preview	PDF Spontaneous/stimulated light emitting .mu.-cavity device	Lebby; Michael et al.	2012-12-11	8
118	US-8331413-B2	Preview	PDF Integrated rare earth devices	Lebby; Michael	2012-12-11	9
119	US-20120280276-A1	Preview	PDF Single Crystal Ge On Si	Dargis; Rytis et al.	2012-11-08	6
120	US-20120256232-A1	Preview	PDF Multilayer Rare Earth Device	Clark; Andrew et al.	2012-10-11	24
121	US-20120183767-A1	Preview	PDF HEXAGONAL REO TEMPLATE BUFFER FOR III-N LAYERS ON SILICON	Dargis; Rytis et al.	2012-07-19	10
122	US-20120145243-A1	Preview	PDF SOLAR CELLS WITH MAGNETICALLY ENHANCED UP-CONVERSION	Williams; David L. et al.	2012-06-14	13
123	US-20120147906-A1	Preview	PDF LASER COOLING OF MODIFIED SOI WAFER	Williams; David L. et al.	2012-06-14	12
124	US-20120104443-A1	Preview	PDF IIIOxNy ON SINGLE CRYSTAL SOI SUBSTRATE AND III n GROWTH PLATFORM	Clark; Andrew et al.	2012-05-03	9
125	US-20120104567-A1	Preview	PDF IIIOxNy ON REO/Si	Clark; Andrew et al.	2012-05-03	6
126	US-20120090672-A1	Preview	PDF REO-Ge Multi-Junction Solar Cell	LEBBY; MICHAEL S. et al.	2012-04-19	16
127	US-20120085399-A1	Preview	PDF REO-Ge Multi-Junction Solar Cell	Lebby; Michael S. et al.	2012-04-12	17
128	US-20120073648-A1	Preview	PDF Photovoltaic conversion using rare earths plus Group IV Sensitizers	Clark; Andrew et al.	2012-03-29	18
129	US-20120019902-A1	Preview	PDF INTERGRATED PUMP LASER AND RARE EARTH WAVEGUIDE AMPLIFIER	Williams; David L. et al.	2012-01-26	10
130	US-20110290313-A1	Preview	PDF SOLAR CELLS WITH ENGINEERED SPECTRAL CONVERSION	LEBBY; MICHAEL et al.	2011-12-01	19
131	US-8049100-B2	Preview	PDF Multijunction rare earth solar cell	Clark; Andrew et al.	2011-11-01	24

132	US-8039738-B2	Preview	PDF Active rare earth tandem solar cell	Clark; Andrew et al.	2011-10-18	25
133	US-8039737-B2	Preview	PDF Passive rare earth tandem solar cell	Clark; Andrew et al.	2011-10-18	17
134	US-20110220173-A1	Preview	PDF ACTIVE SOLAR CONCENTRATOR WITH MULTI-JUNCTION DEVICES	LEBBY; MICHAEL	2011-09-15	15
135	US-20110203666-A1	Preview	PDF HIGH EFFICIENCY SOLAR CELL USING IIIB MATERIAL TRANSITION LAYERS	Lebby; Michael et al.	2011-08-25	10
136	US-20110188533-A1	Preview	PDF INTEGRATED RARE EARTH DEVICES	LEBBY; MICHAEL	2011-08-04	10
137	US-7968384-B2	Preview	PDF Stacked transistors and process	Atanakovic; Petar B. et al.	2011-06-28	7
138	US-7967653-B2	Preview	PDF Full color display	Lebby; Michael et al.	2011-06-28	11
139	US-20110108908-A1	Preview	PDF MULTILAYERED BOX IN FDSOI MOSFETS	Lebby; Michael et al.	2011-05-12	34
140	US-7821066-B2	Preview	PDF Multilayered BOX in FDSOI MOSFETS	Lebby; Michael et al.	2010-10-26	33
141	US-20100122720-A1	Preview	PDF Passive Rare Earth Tandem Solar Cell	Clark; Andrew et al.	2010-05-20	17
142	US-20100116315-A1	Preview	PDF Active rare earth tandem solar cell	Clark; Andrew et al.	2010-05-13	25
143	US-20100112736-A1	Preview	PDF FULL COLOR DISPLAY	Lebby; Michael et al.	2010-05-06	12
144	US-20100109047-A1	Preview	PDF Multijunction rare earth solar cell	Clark; Andrew et al.	2010-05-06	23
145	US-20100084680-A1	Preview	PDF SPONTANEOUS/STIMULATED LIGHT EMITTING .mu.-CAVITY DEVICE	Lebby; Michael et al.	2010-04-08	8
146	US-7643526-B1	Preview	PDF Spontaneous/stimulated light emitting .mu.-cavity device	Lebby; Michael et al.	2010-01-05	8
147	US-20090291535-A1	Preview	PDF STACKED TRANSISTORS AND PROCESS	Atanackovic; Petar B. et al.	2009-11-26	7
148	US-7605531-B1	Preview	PDF Full color display including LEDs with rare earth active areas and different radiative transistions	Lebby; Michael et al.	2009-10-20	11
149	US-7579623-B2	Preview	PDF Stacked transistors and process	Atanackovic; Petar B. et al.	2009-08-25	7
150	US-7538016-B2	Preview	PDF Signal and/or ground planes with double buried insulator layers and fabrication process	Atanakovic; Petar B. et al.	2009-05-26	8

151	US-7388230-B1	Preview	PDF Selective colored light emitting diode	Lebby; Michael et al.	2008-06-17	9
152	US-20080135924-A1	Preview	PDF Multilayered box in FDSOI MOSFETS	Lebby; Michael et al.	2008-06-12	34
153	US-7365357-B2	Preview	PDF Strain inducing multi-layer cap	Atanackovic; Petar B. et al.	2008-04-29	6
154	US-20080093670-A1	Preview	PDF SIGNAL AND/OR GROUND PLANES WITH DOUBLE BURIED INSULATOR LAYERS AND FABRICATION PROCESS	Atanackovic; Petar B. et al.	2008-04-24	8
155	US-7355269-B1	Preview	PDF IC on non-semiconductor substrate	Lebby; Michael et al.	2008-04-08	4
156	US-7323396-B2	Preview	PDF Signal and/or ground planes with double buried insulator layers and fabrication process	Atanackovic; Petar B. et al.	2008-01-29	7
157	US-20070018166-A1	Preview	PDF Stacked transistors and process	Atanackovic; Petar B. et al.	2007-01-25	8
158	US-20070018203-A1	Preview	PDF Strain inducing multi-layer cap	Atanackovic; Petar B. et al.	2007-01-25	6
159	US-20060246691-A1	Preview	PDF Signal and/or ground planes with double buried insulator layers and fabrication process	Atanackovic; Petar B. et al.	2006-11-02	8
160	US-6999644-B1	Preview	PDF Discrete optoelectric package	Lebby; Michael S. et al.	2006-02-14	17
161	US-6966703-B1	Preview	PDF Self eject latch mechanism for an optical transceiver module	Lebby; Michael S. et al.	2005-11-22	9
162	US-6795461-B1	Preview	PDF Optoelectric module	Blair; Thomas H. et al.	2004-09-21	19
163	US-6663296-B1	Preview	PDF Optoelectric module	Blair; Thomas H. et al.	2003-12-16	14
164	US-6412989-B1	Preview	PDF Directable laser transmission module	Hartman; Davis Howard et al.	2002-07-02	8

165	US-6243056-B1	Preview	PDF Transceiver with miniature virtual image display	Jachimowicz; Karen E. et al.	2001-06-05	12
166	US-6228440-B1	Preview	PDF Perishable media information storage mechanism and method of fabrication	Dailey; Conan B. et al.	2001-05-08	7
167	US-6158884-A	Preview	PDF Integrated communicative watch	Lebby; Michael S. et al.	2000-12-12	9
168	US-6161106-A	Preview	PDF Perishable media system and method of operation	Dailey; Conan B. et al.	2000-12-12	7
169	US-6156582-A	Preview	PDF Method of fabricating top emitting ridge VCSEL with self-aligned contact and sidewall reflector	Shieh; Chan-Long et al.	2000-12-05	6
170	US-6131017-A	Preview	PDF Dual system portable electronic communicator	Lebby; Michael S. et al.	2000-10-10	8
171	US-6122023-A	Preview	PDF Non-speckle liquid crystal projection display	Chen; Diana et al.	2000-09-19	8
172	US-6121068-A	Preview	PDF Long wavelength light emitting vertical cavity surface emitting laser and method of fabrication	Ramdani; Jamal et al.	2000-09-19	7
173	US-6115618-A	Preview	PDF Portable electronic device with removable display	Lebby; Michael S. et al.	2000-09-05	6
174	US-6111839-A	Preview	PDF Optical pickup head including a coherent first order mode laser light source	Milster; Tom D. et al.	2000-08-29	7
175	US-6096666-A	Preview	PDF Holographic textile fiber	Jachimowicz; Karen E. et al.	2000-08-01	6
176	US-6097748-A	Preview	PDF Vertical cavity surface emitting laser semiconductor chip with integrated drivers and photodetectors and method of fabrication	Huang; Rong-Ting et al.	2000-08-01	11
177	US-6097528-A	Preview	PDF Microscanner for portable laser diode displays	Lebby; Michael S. et al.	2000-08-01	8
178	US-6091754-A	Preview	PDF VCSEL having integrated photodetector for automatic power control	Jiang; Wenbin et al.	2000-07-18	5

179	US-6084697-A	Preview	PDF Integrated electro-optical package	Lebby; Michael S. et al.	2000-07-04	9
180	US-6080690-A	Preview	PDF Textile fabric with integrated sensing device and clothing fabricated thereof	Lebby; Michael S. et al.	2000-06-27	8
181	US-6069593-A	Preview	PDF Display carrier and electronic display control for multiple displays in a portable electronic device	Lebby; Michael S. et al.	2000-05-30	6
182	US-6064780-A	Preview	PDF Interconnect substrate with a single contact accessible in an upper and an end surface	Blair; Thomas H. et al.	2000-05-16	6
183	US-6061380-A	Preview	PDF Vertical cavity surface emitting laser with doped active region and method of fabrication	Jiang; Wenbin et al.	2000-05-09	8
184	US-6061485-A	Preview	PDF Method for wavelength division multiplexing utilizing donut mode vertical cavity surface emitting lasers	Jiang; Wenbin et al.	2000-05-09	7
185	US-6029073-A	Preview	PDF Display carrier with binocular viewing for a portable electronic device	Lebby; Michael S. et al.	2000-02-22	7
186	US-6026111-A	Preview	PDF Vertical cavity surface emitting laser device having an extended cavity	Jiang; Wenbin et al.	2000-02-15	6
187	US-6022760-A	Preview	PDF Integrated electro-optical package and method of fabrication	Lebby; Michael S. et al.	2000-02-08	12
188	US-6021146-A	Preview	PDF Vertical cavity surface emitting laser for high power single mode operation and method of fabrication	Jiang; Wenbin et al.	2000-02-01	7
189	US-6021147-A	Preview	PDF Vertical cavity surface emitting laser for high power single mode operation and method of fabrication	Jiang; Wenbin et al.	2000-02-01	7
190	US-6008067-A	Preview	PDF Fabrication of visible wavelength vertical cavity surface emitting laser	Ramdani; Jamal et al.	1999-12-28	5
191	US-5978398-A	Preview	PDF Long wavelength vertical cavity surface emitting laser	Ramdani; Jamal et al.	1999-11-02	5
192	US-5974071-A	Preview	PDF VCSEL with integrated photodetectors for automatic power control and signal detection in data storage	Jiang; Wenbin et al.	1999-10-26	8

193	US-5966399-A	Preview	PDF Vertical cavity surface emitting laser with integrated diffractive lens and method of fabrication	Jiang; Wenbin et al.	1999-10-12	7
194	US-5959315-A	Preview	PDF Semiconductor to optical link	Lebby; Michael S. et al.	1999-09-28	6
195	US-5956363-A	Preview	PDF Long wavelength vertical cavity surface emitting laser with oxidation layers and method of fabrication	Lebby; Michael S. et al.	1999-09-21	7
196	US-5956364-A	Preview	PDF Vertical cavity surface emitting laser with shaped cavity mirror and method of fabrication	Jiang; Wenbin et al.	1999-09-21	6
197	US-5953355-A	Preview	PDF Semiconductor laser package with power monitoring system	Kiely; Philip et al.	1999-09-14	6
198	US-5946121-A	Preview	PDF IrDA data link with VCSEL light source	Jiang; Wenbin et al.	1999-08-31	4
199	US-5943359-A	Preview	PDF Long wavelength VCSEL	Ramdani; Jamal et al.	1999-08-24	5
200	US-5943357-A	Preview	PDF Long wavelength vertical cavity surface emitting laser with photodetector for automatic power control and method of fabrication	Lebby; Michael S. et al.	1999-08-24	7
201	US-5939773-A	Preview	PDF Semiconductor laser package including a lead frame and plastic resin housing	Jiang; Wenbin et al.	1999-08-17	8
202	US-5936929-A	Preview	PDF Optical submodule and method for making	Jiang; Wenbin et al.	1999-08-10	7
203	US-5923696-A	Preview	PDF Visible light emitting vertical cavity surface emitting laser with gallium phosphide contact layer and method of fabrication	Ramdani; Jamal et al.	1999-07-13	7
204	US-5914973-A	Preview	PDF Vertical cavity surface emitting laser for high power operation and method of fabrication	Jiang; Wenbin et al.	1999-06-22	7
205	US-5906004-A	Preview	PDF Textile fabric with integrated electrically conductive fibers and clothing fabricated thereof	Lebby; Michael S. et al.	1999-05-25	7
206	US-5905750-A	Preview	PDF Semiconductor laser package and method of fabrication	Lebby; Michael S. et al.	1999-05-18	10
207	US-5903586-A	Preview	PDF Long wavelength vertical cavity surface emitting laser	Ramdani; Jamal et al.	1999-05-11	5
208	US-5898722-A	Preview	PDF Dual wavelength monolithically integrated vertical cavity surface emitting lasers and method of fabrication	Ramdani; Jamal et al.	1999-04-27	8

209	US-5886972-A	Preview PDF	Recording information in a phase change optical medium with a vertical cavity surface emitting laser	Jiang; Wenbin et al.	1999-03-23	5
210	US-5883912-A	Preview PDF	Long wavelength VCSEL	Ramdani; Jamal et al.	1999-03-16	5
211	US-5881084-A	Preview PDF	Semiconductor laser for package with power monitoring system	Huang; Rong-Ting et al.	1999-03-09	8
212	US-5848086-A	Preview PDF	Electrically confined VCSEL	Lebby; Michael S. et al.	1998-12-08	7
213	US-5838703-A	Preview PDF	Semiconductor laser package with power monitoring system and optical element	Lebby; Michael S. et al.	1998-11-17	9
214	US-5838707-A	Preview PDF	Ultraviolet/visible light emitting vertical cavity surface emitting laser and method of fabrication	Ramdani; Jamal et al.	1998-11-17	8
215	US-5835521-A	Preview PDF	Long wavelength light emitting vertical cavity surface emitting laser and method of fabrication	Ramdani; Jamal et al.	1998-11-10	7
216	US-5831960-A	Preview PDF	Integrated vertical cavity surface emitting laser pair for high density data storage and method of fabrication	Jiang; Wenbin et al.	1998-11-03	7
217	US-5821571-A	Preview PDF	Dual sided integrated electro-optical package	Lebby; Michael S. et al.	1998-10-13	13
218	US-5818404-A	Preview PDF	Integrated electro-optical package	Lebby; Michael S. et al.	1998-10-06	18
219	US-5815524-A	Preview PDF	VCSEL including GaTIP active region	Ramdani; Jamal et al.	1998-09-29	5
220	US-5796769-A	Preview PDF	Red light vertical cavity surface emitting laser	Ramdani; Jamal et al.	1998-08-18	6
221	US-5789733-A	Preview PDF	Smart card with contactless optical interface	Jachimowicz; Karen E. et al.	1998-08-04	7
222	US-5774486-A	Preview PDF	Waveguide power monitoring system for vertical cavity surface emitting lasers	Jiang; Wenbin et al.	1998-06-30	6
223	US-5764671-A	Preview PDF	VCSEL with selective oxide transition regions	Lebby; Michael S. et al.	1998-06-09	10
224	US-5757741-A	Preview PDF	CD ROM head with VCSEL or VCSEL array	Jiang; Wenbin et al.	1998-05-26	11
225	US-5757829-A	Preview PDF	Flip chip power monitoring system for vertical cavity surface emitting lasers	Jiang; Wenbin et al.	1998-05-26	6
226	US-5757836-A	Preview PDF	Vertical cavity surface emitting laser with laterally integrated photodetector	Jiang; Wenbin et al.	1998-05-26	8
227	US-5751757-A	Preview PDF	VCSEL with integrated MSM photodetector	Jiang; Wenbin et al.	1998-05-12	5

228 US-5751471-A	Preview PDF Switchable lens and method of making	Chen; Diana et al.	1998-05- 8 12
229 US-5748665-A	Preview PDF Visible VCSEL with hybrid mirrors	Jiang; Wenbin et al.	1998-05- 7 05
230 US-5748161-A	Preview PDF Integrated electro-optical package with independent menu bar	Lebby; Michael S. et al.	1998-05- 22 05
231 US-5742630-A	Preview PDF VCSEL with integrated pin diode	Jiang; Wenbin et al.	1998-04- 6 21
232 US-5741724-A	Preview PDF Method of growing gallium nitride on a spinel substrate	Ramdani; Jamal et al.	1998-04- 5 21
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234 US-5732103-A	Preview PDF Long wavelength VCSEL	Ramdani; Jamal et al.	1998-03- 5 24
235 US-5719892-A	Preview PDF Hybrid mirror structure for a visible emitting VCSEL	Jiang; Wenbin et al.	1998-02- 8 17
236 US-5719893-A	Preview PDF Passivated vertical cavity surface emitting laser	Jiang; Wenbin et al.	1998-02- 7 17
237 US-5710441-A	Preview PDF Microcavity LED with photon recycling	Ackley; Donald E. et al.	1998-01- 5 20
238 US-5708280-A	Preview PDF Integrated electro-optical package and method of fabrication	Lebby; Michael S. et al.	1998-01- 12 13
239 US-5706306-A	Preview PDF VCSEL with distributed Bragg reflectors for visible light	Jiang; Wenbin et al.	1998-01- 6 06
240 US-5703664-A	Preview PDF Integrated electro-optic package for reflective spatial light modulators	Jachimowicz; Karen E. et al.	1997-12- 13 30
241 US-5699073-A	Preview PDF Integrated electro-optical package with carrier ring and method of fabrication	Lebby; Michael S. et al.	1997-12- 19 16
242 US-5661075-A	Preview PDF Method of making a VCSEL with passivation	Grodzinski; Piotr et al.	1997-08- 9 26
243 US-5654228-A	Preview PDF VCSEL having a self-aligned heat sink and method of making	Shieh; Chan-Long et al.	1997-08- 7 05
244 US-5644369-A	Preview PDF Switchable lens/diffuser	Jachimowicz; Karen E. et al.	1997-07- 8 01
245 US-5638392-A	Preview PDF Short wavelength VCSEL	Ramdani; Jamal et al.	1997-06- 6 10
246 US-5636298-A	Preview PDF Coalescing optical module and method for making	Jiang; Wenbin et al.	1997-06- 8 03

247 US-5633886-A	Preview PDF Short wavelength VCSEL with Al-free active region	Ramdani; Jamal et al.	1997-05-27	6
248 US-5625734-A	Preview PDF Optoelectronic interconnect device and method of making	Thomas; Ronald E. et al.	1997-04-29	7
249 US-5574744-A	Preview PDF Optical coupler	Gaw; Craig A. et al.	1996-11-12	7
250 US-5563900-A	Preview PDF Broad spectrum surface-emitting led	Ackley; Donald E. et al.	1996-10-08	7
251 US-5557626-A	Preview PDF Patterned mirror VCSEL with adjustable selective etch region	Grodzinski; Piotr et al.	1996-09-17	8
252 US-5555341-A	Preview PDF Waveguide with an electrically conductive channel	Sharma; Ravinder K. et al.	1996-09-10	7
253 US-5550941-A	Preview PDF Optoelectronic interface module	Lebby; Michael S. et al.	1996-08-27	8
254 US-5545359-A	Preview PDF Method of making a plastic molded optoelectronic interface	Ackley; Donald E. et al.	1996-08-13	9
255 US-5546413-A	Preview PDF Integrated light emitting device	Lebby; Michael S. et al.	1996-08-13	10
256 US-5543958-A	Preview PDF Integrated electro-optic package for reflective spatial light modulators	Lebby; Michael S. et al.	1996-08-06	14
257 US-5540799-A	Preview PDF Method of fabricating optical waveguide from a laminate	Lebby; Michael S. et al.	1996-07-30	6
258 US-5538919-A	Preview PDF Method of fabricating a semiconductor device with high heat conductivity	Lebby; Michael S. et al.	1996-07-23	8
259 US-5539200-A	Preview PDF Integrated optoelectronic substrate	Lebby; Michael S. et al.	1996-07-23	6
260 US-5539554-A	Preview PDF Integrated electro-optic package for reflective spatial light	Lebby; Michael S. et al.	1996-07-23	14
261 US-5534888-A	Preview PDF Electronic book	Lebby; Michael S. et al.	1996-07-09	8
262 US-5530715-A	Preview PDF Vertical cavity surface emitting laser having continuous grading	Shieh; Chan-Long et al.	1996-06-25	7
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264 US-5517348-A	Preview PDF Voltage controlled transparent layer for a bi-directional device	Lebby; Michael S.	1996-05-14	5
265 US-5511138-A	Preview PDF Interlocking waveguide and method of making	Lebby; Michael S. et al.	1996-04-23	8

266	US-5498883-A	Preview PDF	Superluminescent edge emitting device with apparent vertical light emission and method of making	Lebby; Michael S. et al.	1996-03-12	7
267	US-5493437-A	Preview PDF	External communication link for a credit card pager	Lebby; Michael S. et al.	1996-02-20	10
268	US-5491491-A	Preview PDF	Portable electronic equipment with binocular virtual display	Lebby; Michael S. et al.	1996-02-13	11
269	US-5486946-A	Preview PDF	Integrated electro-optic package for reflective spatial light modulators	Jachimowicz; Karen E. et al.	1996-01-23	14
270	US-5485318-A	Preview PDF	Dual image manifestation apparatus with integrated electro-optical package	Lebby; Michael S. et al.	1996-01-16	17
271	US-5482658-A	Preview PDF	Method of making an optoelectronic interface module	Lebby; Michael S. et al.	1996-01-09	8
272	US-5482891-A	Preview PDF	VCSEL with an intergrated heat sink and method of making	Shieh; Chan-Long et al.	1996-01-09	6
273	US-5478774-A	Preview PDF	Method of fabricating patterned-mirror VCSELs using selective growth	Ackley; Donald E. et al.	1995-12-26	7
274	US-5473716-A	Preview PDF	Fiber bundle interconnect and method of making same	Lebby; Michael S. et al.	1995-12-05	8
275	US-5468656-A	Preview PDF	Method of making a VCSEL	Shieh; Chan-Long et al.	1995-11-21	9
276	US-5469185-A	Preview PDF	Remote sensory unit and driver	Lebby; Michael S. et al.	1995-11-21	7
277	US-5468582-A	Preview PDF	Fused optical layer and method of making	Blair; Thomas H. et al.	1995-11-21	7
278	US-5466633-A	Preview PDF	Optical reading head and method for making same	Ackley; Donald E. et al.	1995-11-14	11
279	US-5467215-A	Preview PDF	Integrated electro-optic package for reflective spatial light modulators	Lebby; Michael S. et al.	1995-11-14	13
280	US-5452387-A	Preview PDF	Coaxial optoelectronic mount and method of making same	Chun; Christopher K. Y. et al.	1995-09-19	5
281	US-5446752-A	Preview PDF	VCSEL with current blocking layer offset	Ackley; Donald E. et al.	1995-08-29	10
282	US-5437092-A	Preview PDF	Method of making contact areas on an optical waveguide	Hartman; Davis H. et al.	1995-08-01	7
283	US-5432809-A	Preview PDF	VCSEL with Al-free cavity region	Grodzinski; Piotr et al.	1995-07-11	7
284	US-5432630-A	Preview PDF	Optical bus with optical transceiver modules and method of manufacture	Lebby; Michael S. et al.	1995-07-11	16

285	US-5428704-A	Preview PDF	Optoelectronic interface and method of making	Lebby; Michael S. et al.	1995-06-27	16
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296	US-5367593-A	Preview PDF	Optical/electrical connector and method of fabrication	Lebby; Michael S. et al.	1994-11-22	10
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- 2) Thesis: Fabrication and characterization of the heterojunction field effect transistor and the bipolar inversion channel field effect transistor
 - a. 1987
 - b. Characterization of HFETs and BICFETs fabricated from GaAs/AlGaAs with magnetron ion etching, sputtered tungsten gates, ion implanted source/drain contacts and rapid thermal anneals.
 - c. University of Bradford, UK 1987
 - d. <http://www.edt.brad.ac.uk/home/>
- 3) <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1486581> Paper: Very high-transconductance heterojunction field-effect transistor (HFET)
 - a. Jan 1987
 - b. "A new form of FET has been demonstrated in the GaAs/AlGaAs material system. Designated the HFET, it has shown a transconductance of 500mS/mm at 300 K for a nominal $L_g = 2/\mu m$ and a drain current of 430mA/mm. The conduction occurs in an inversion channel at the heterointerface"
 - c. "Electronics Letters Volume: 23, Issue: 2 Digital Object Identifier: 10.1049/el:19870056 Publication Year: 1987 , Page(s): 77 - 79"
 - d. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4257306>
- 4) Talk and abstract: Magnetron Ion Etching of self aligned HFETs
 - a. May 1987
 - b. Electrochemical Society (ECS) Conference proceedings SOTAPOCS VI, Compound Semiconductors, Philadelphia
 - c. http://www.electrochem.org/meetings/biannual/past_meetings_list.htm

1988

- 5) Paper: Demonstration of a p-channel GaAs/AlGaAs BICFET
 - a. Feb 1988
 - b. "Electron Device Letters, IEEE Volume: 9, Issue: 2 Digital Object Identifier: 10.1109/55.2048 Publication Year: 1988 , Page(s): 84 - 86"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=2048>
- 6) Paper: GaAs/AlGaAs inversion channel devices for an integrated opto-electronic technology
 - a. Jun 1988
 - b. "Electron Devices, IEEE Transactions on Volume: 35, Issue: 12 Digital Object Identifier: 10.1109/16.8871 Publication Year: 1988"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8871>
- 7) Paper: A p-channel BICFET in the InGaAs/InAlAs material system
 - a. Jun 1988

- b. "Electron Device Letters, IEEE Volume: 9, Issue: 6 Digital Object Identifier: 10.1109/55.716 Publication Year: 1988 , Page(s): 278 - 280"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=716&tag=1>
- 8) Paper: An inversion channel technology for opto-electronic integration
 - a. Sep 1988
 - b. "Optical Communication, 1988. (ECOC 88). Fourteenth European Conference on (Conf. Publ. No.292), Publication Year: 1988, Page(s): 211 - 214 vol.1"
- 9) <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=93560> Paper: Performance and advantages of BICFETs versus HBTs
 - a. Sep 1988
 - b. "Bipolar Circuits and Technology Meeting, 1988., Proceedings of the 1988 Digital Object Identifier: 10.1109/BIPOL.1988.51041 Publication Year: 1988 , Page(s): 41- 45"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=51041>
- 10) Talk and abstract: RIE and MIE comparison for optoelectronic integrated circuit processing
 - a. Nov 1988
 - b. IEEE LEOS Conference, Santa Clara, California
- 11) Paper: Reactive ion etching (RIE) and magnetron ion etching (MIE) combinations for opto-electronic integrated circuit (OEIC) processing
 - a. Nov 1988
 - b. Proc. SPIE Vol. 1037, p. 88, Monitoring and Control of Plasma-Enhanced Processing of Semiconductors, James E. Griffiths; Ed.
 - c. http://spie.org/x648.html?product_id=951018

1989

- 1) Paper: An n-channel BICFET in the InGaAs/InAlGaAs/InAlAs material system
 - a. 1989
 - b. "Electron Device Letters, IEEE Volume: 10 , Issue: 7 Digital Object Identifier: 10.1109/55.29660 Publication Year: 1989 , Page(s): 304 - 306"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=29660&tag=1>
- 2) Paper: An n-channel BICFET in the GaAs/AlGaAs material system
 - a. Feb 1989
 - b. "Electron Device Letters, IEEE Volume: 10, Issue: 2 Digital Object Identifier: 10.1109/55.32438 Publication Year: 1989 , Page(s): 88 - 90"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=32438&tag=1>
- 3) Paper: An Inversion Channel Technology For Opto-Electronic Integration
 - a. 8th Feb 1989

- b. A new approach to optoelectronic integration is reported which combines electronic and optical devices fabricated with a common sequence and a single MBE wafer growth. The devices have in common, an inversion layer structure produced by charge sheet doping.
- c. Proceedings Vol. 0994 Optoelectronic Materials, Devices, Packaging, and Interconnects II, Glen M. McWright; Henry J. Wojtunik, Editors, pp.251-510
Date: 9 February 1989 ISBN: 9780819400291
- d. http://spie.org/x648.html?product_id=960136

1991

- 4) Invited talk and abstract: Use of VCSELs for the MONSOON parallel digital computer
 - a. Jan 1991
 - b. International workshop on architectures for free-space digital computing, Colorado.
- 5) Invited Paper and Presentation: Approaching the problem of high-density interconnects in the 'Monsoon' data-flow parallel processor with optics"
 - a. 28th Jan 1991
 - b. AFOSR, ONR, DARPA: A compendium of position papers from the workshop on architectures for free space digital optical computing
 - c. http://www.researchgate.net/publication/235184814_A_Compendium_of_Position_Papers_from_the_Workshop_on_Architectures_for_Free_Space_Digital_Optical_Computing_Held_in_Vail_Colorado_on_28-30_January_1991

1993

- 6) Invited talk and abstract: Optoelectronic Devices and Applications
 - a. 1993
 - b. IEEE workshop on optical interconnects
- 7) Invited talk and abstract: VCSEL Technology and Progress
 - a. 1993
 - b. IEEE Waves and Devices, Phoenix Section, Tempe, Arizona, Arizona State University

1994

- 8) Invited talk and abstract: Ridge waveguide VCSELs: improvement over planar VCSELs
 - a. May 1994
 - b. USA Laser workshop, CLEO, Baltimore, MD
- 9) Invited talk and abstract: Packaging VCSELs with GUIDECAST(tm) an overmolded waveguide packaging platform
 - a. Aug 1994
 - b. IEEE Tropical workshop on optoelectronic packaging, Breckenridge, Colorado.

1995

- 10) Paper: Parallel optical interconnects using VCSELs
 - a. 1995
 - b. "High Speed Semiconductor Devices and Circuits, 1995. Proceedings., IEEE/Cornell Conference on Advanced Concepts in Digital Object Identifier: 10.1109/CORNEL.1995.482526 Publication Year: 1995 , Page(s): 348 - 356"
 - c. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=482526>
- 11) Book: Research in VCSEL devices - Annual technical review 1995
 - a. 1995
 - b. Annual collection of optoelectronic device and reliability department papers at the photonics technology center, Motorola, Tempe, USA.
 - c. Key focus was the commercialization of VCSEL technology, especially at 850nm for the Optobus™ parallel array product and other associated VCSEL prototypes.
 - d. Motorola
- 12) Invited talk and abstract: Ridge waveguide VCSEL device performance
 - a. May 1995
 - b. USA Laser workshop, CLEO, Anaheim, California
- 13) Invited talk and abstract: VCSEL Arrays and GUIDECAST(tm) packaging technology as used in OPTOBUS(tm)
 - a. Sep 1995
 - b. European Laser Workshop, Eindhoven, Netherlands

1996

- 14) Book: Research in optoelectronic devices volume II
- 1996
 - Annual collection of optoelectronic device and reliability department papers at the photonics technology center, Motorola, Tempe, USA. Key focus was the commercialization of VCSEL technology, especially at 850nm for the optobus parallel array product and other associated VCSEL prototypes. Demonstration of 660nm VCSELs discussed.
 - Motorola
- 15) Paper: Low-cost high-performance optical interconnect
- 1996
 - Proceedings, Conference on Lasers and Electro-Optics, (CLEO), vol 9, 1996
 - <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=864750>
- 16) Paper: Key challenges and results of VCSELs in data links
- 1996
 - "Lasers and Electro-Optics Society Annual Meeting, 1996. LEOS 96., IEEE Volume: 2 Digital Object Identifier: 10.1109/LEOS.1996.571604 Publication Year: 1996 , Page(s): 167 - 168 vol.2"
 - <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=571604>
- 17) Paper: A low-cost high-performance optical interconnect
- 1996
 - "Components, Packaging, and Manufacturing Technology, Part B: Advanced Packaging, IEEE Transactions on Volume: 19 , Issue: 3 Digital Object Identifier: 10.1109/96.533892 Publication Year: 1996 , Page(s): 532- 539"
 - <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=533892>
- 18) Paper: Characteristics of VCSEL arrays for parallel optical interconnects
- 1996
 - "Electronic Components and Technology Conference, 1996. Proceedings., 46th Digital Object Identifier: 10.1109/ECTC.1996.517404 Publication Year: 1996 , Page(s): 279 - 291"
 - <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=517404>
- 19) Paper: Use of VCSEL arrays for parallel optical interconnects
- 10th Apr 1996
 - Proc. SPIE 2683, Fabrication, Testing, and Reliability of Semiconductor Lasers, 81 (April 10, 1996); doi:10.1117/12.237679
 - <http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=1015866>
- 20) Paper: A low-cost high-performance optical interconnect
- Aug 1996
 - The Optobus™ link is a ten channel parallel bidirectional data link based on multimode fiber ribbons. The guiding principal of the Optobus™ design was to produce an optical interconnect capable of competing with copper on price, not just performance. Recognizing that packaging dominates the cost of optical

- interconnects, the design focused on minimizing the complexity of the optical subassembly. A key component of this strategy is the use of AlGaAs/GaAs vertical cavity surface emitting lasers (VCSELs). Another is designing the silicon receiver and transmitter arrays around the module level packaging parasitics. The resulting parallel transceiver modules achieve a minimum throughput of 1.5 Gb/s in each direction with a power dissipation of 1.6 W
- c. Components, Packaging, and Manufacturing Technology, Part B: Advanced Packaging, IEEE Transactions on Volume: 19 , Issue: 3 Page(s): 532- 539
 - d. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=533892>
- 21) Invited talk and abstract: Ridge Waveguide and Planar VCSEL Device Reliability
- a. Sep 1996
 - b. European Laser Workshop, Oslo, Norway
- 22) Invited talk and abstract: Vertical cavity surface emitting lasers for communication applications
- a. Oct 1996
 - b. Optical Society of America (OSA) Annual meetings, proceedings, paper WR1, Rochester, NY
- 23) Paper: Characteristics of VCSELs and VCSEL arrays for Optical Data Links
- a. 10th Dec 1996
 - b. Motorola: Technical Enrichment Matrix Conference, Motorola SPS- SABA, Hilton Pavilion, Mesa, Az

1997

- 24) Paper: Effect of proton implantation on the degradation of GaAs/AlGaAs vertical cavity surface emitting lasers
- a. 1997
 - b. Electronics Letters, ISSN 0013-5194, 1997, Volume 33, Issue 2, p. 137
 - c. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=579434>
- 25) Paper (invited): Laser safety issues with VCSEL arrays in OPTOBUS(tm)
- a. 1997
 - b. Optical Society of America (OSA); Annual Meeting, Micro-optics session
- 26) Paper: Relative intensity noise of 780nm vertical cavity surface emitting lasers Jan 1997
- a. Proceedings of the 1997 Pacific Rim Conference on Lasers and Electro-Optics, CLEO/Pacific Rim, No 46984, Jan 1997
 - b. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=610586>
- 27) Paper: Characteristics of VCSELs and VCSEL arrays for optical data links
- a. Feb 1997

- b. Proc. SPIE 3004, Fabrication, Testing, and Reliability of Semiconductor Lasers II, 122 (May 1, 1997); doi:10.1117/12.273825
 - c. <http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=918720>
- 28) Paper: Parallel interconnect for a novel system approach to short distance high information transfer data links
 - a. April 1997
 - b. Proceedings of SPIE, ISSN 0277-786X, 04/1997, Volume 3038, Issue 1
 - c. <http://www.deepdyve.com/lp/spie/parallel-interconnect-for-a-novel-system-approach-to-short-distance-RFreDaEJjb>
- 29) Paper: Vertical cavity surface emitting laser packaging with auto power control
 - a. May 1997
 - b. Proceedings, 47th Electronic Components and Technology Conference, pp. 368-370, May 1997
 - c. http://www.researchgate.net/publication/3700010_Vertically_cavity_surface_emitting_laser_packaging_with_auto_powercontrol
- 30) Course (peer reviewed): "Optoelectronic devices and packaging"
 - a. May 1997
 - b. IEEE ECTC
 - c. <http://www.ectc.net>
- 31) Paper: Vertical cavity surface emitting laser packaging with auto power control
 - a. 18th May 1997
 - b. Electronic Components and Technology Conference, 1997. Proceedings., 47th
 - c. [http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=606195&contentType=Conference+Publications&sortType%3Dasc_p_Sequence%26filter%3DAND\(p_IS_Number%3A13278\)](http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=606195&contentType=Conference+Publications&sortType%3Dasc_p_Sequence%26filter%3DAND(p_IS_Number%3A13278))
- 32) Invited Talk and Abstract: VCSEL/detector technology for parallel optical interconnects
 - a. 17th Jun 1997
 - b. International Workshop for new technologies, interconnects, and communications in distributed and parallel systems by IRIT, ONERA, CERT, CNRS, and LAAS (France)
- 33) Invited talk and abstract: Vertical cavity surface emitting lasers and applications
 - a. Sep 1997
 - b. European Laser Workshop, Glasgow, Scotland

1998

- 34) Course and Tutorial: Optoelectronic Devices and Packaging: VCSEL Technology
 - a. Jan 1998

- b. "Optoelectronic devices and packaging have found increasing use in many new products over the last 20 Yrs. This tutorial primarily will focus on semiconductor laser based technology with particular emphasis on emerging new technologies such as the Vertical Cavity Surface Emitting Laser (VCSEL) and how to take advantage of its uniqueness in packaging. The tutorial will look at the driving factors required for low cost high volume VCSEL based packages and what impact they will have in tomorrow's products. As there are many packaging solutions for VCSEL based technology proposed, the course will show the relative merits of popular new technologies with respect to high volume and low cost manufacturing.
 - c. 4th IEEE Workshop on AST Phoenix Research Center
 - d. <http://www.ewh.ieee.org/soc/cpmt/ast98/lebbby-01.ppt>
- 35) Paper: ORMOCERs - new photo-patternable dielectric and optical materials for MCM-packaging
- a. Jan 1998
 - b. Hybrid inorganic-organic polymers (ORMOCERs*) have been developed and tested in an ongoing EU-program (BE 7250 DONDOMCM) for evaluation in MCM applications. The photopatternable materials with negative resist behavior are composed of inorganic oxidic structures cross-linked or substituted by organic groups. They are prepared from organosilane precursors by sol-gel-processing in combination with organic crosslinking of polymerizable organic functions. As a result of these functionalities the properties of the ORMOCERs can be adjusted to particular applications. Systematic variation of composition combined with adaptation to micro system technology allows great flexibility in processing. Some features of these materials are: Postbaking at moderate temperatures (120 °C - 180 °C) enables processing on substrates such as FR-4 and BT. Combined use as dielectric and passivation layers in electrical systems and devices as well as core and cladding for optical applications enables e/o applications with high integration levels. Easily adaptable to thin film technology: spin-on with planarization >90% and via diameters down to 20 µm have been achieved
 - c. Proceedings of the 1998 48th Electronic Components and Technology Conference
 - d. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=678838&contentType=Conference+Publications>
- 36) Paper and Invited talk: VCSEL Devices and Packaging for Fiber Optic Transceivers
- a. 30th Mar 1998
 - b. OSA Technical Digest: Integrated Photonics Research (IPR) 1998 paper: IWD1
 - c. <http://www.opticsinfobase.org/abstract.cfm?URI=IPR-1998-IWD1>
- 37) Paper: Automatic power control of a VCSEL using an angled lid TO56 package
- a. May 1998
 - b. 1998 Proceedings. 48th Electronic Components and Technology Conference

- c. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=678694&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel4%2F5582%2F14953%2F00678694.pdf%3Farnumber%3D678694>
- 38) Paper: O/e-MCM packaging with new, patternable dielectric and optical materials
- a. May 1998
 - b. Electronic Components & Technology Conference, 1998. 48th IEEE
 - c. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=678929&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel4%2F5582%2F14953%2F00678929.pdf%3Farnumber%3D678929>
- 39) Paper: ORMOCERs(TM)-new photo-patternable dielectric and optical materials for MCM-packaging
- a. May 1998
 - b. Hybrid inorganic-organic polymers (ORMOCERs*) have been developed and tested in an ongoing EU-program (BE 7250 DONDOMCM) for evaluation in MCM applications. The photo-patternable materials with negative resist behavior are composed of inorganic oxidic structures cross-linked or substituted by organic groups. They are prepared from organosilane precursors by sol-gel-processing in combination with organic crosslinking of polymerizable organic functions. As a result of these functionalities the properties of the ORMOCERs can be adjusted to particular applications. Systematic variation of composition combined with adaptation to micro system technology allows great flexibility in processing. Some features of these materials are: Post baking at moderate temperatures (120 °C - 180 °C) enables processing on substrates such as FR-4 and BT. Combined use as dielectric and passivation layers in electrical systems and devices as well as core and cladding for optical applications enables e/o applications with high integration levels. Easily adaptable to thin film technology: spin-on with planarization >90% and via diameters down to 20 µm have been achieved
 - c. 1998 Proceedings. 48th Electronic Components and Technology Conference
 - d. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=678838&contentType=Conference+Publications>
- 40) Course (peer reviewed): "Optoelectronic devices and packaging: VCSEL technology"
- a. May 1998
 - b. IEEE ECTC
 - c. <http://www.ectc.net>
- 41) Co-Chairman Optoelectronics session, 48th ECTC Conference
- a. 25th May 1998
 - b. Co-chairman Optoelectronics session, 48th ECTC Conference Seattle, Washington
 - c. ECTC, IEEE-CPMT, EIA/ECA
 - d. <http://www.ectc.net>
- 42) Invited Presentation and Abstract: VCSEL Technology - VCSEL technology is discussed with the work between AMP and MODE (division of EMCORE) fiber optics.

- a. Sep 1998
 - b. ECOC European Laser Workshop (in association with ECOC 1998, Madrid, Spain)
 - c. https://openlibrary.org/books/OL22322573M/ECOC_'98_24th_European_Conference_on_Optical_Communication
 - d.
- 43) Paper: Optical bistability in vertical cavity surface emitting lasers with a simple intra-cavity epitaxial absorber layer
- a. 4th Oct 1998
 - b. Conference Digest: Semiconductor Laser Conference, 1998. ISLC 1998 NARA. 1998 IEEE 16th International
- 44) Talk: Optical bistability in vertical cavity surface emitting lasers with a simple intra-cavity epitaxial absorber layer
- a. 4th Oct 1998
 - b. Conference Digest: Semiconductor Laser Conference, 1998. ISLC 1998 NARA. 1998 IEEE 16th International
 - c.
- 45) Paper: Vertical cavity surface emitting laser-based parallel optical data link
- a. Dec 1998
 - b. Optical Engineering, vol 37, no. 12, pp.3113-18, Dec. 1998.
 - c. http://spie.org/x648.html?product_id=318648
- 46) Paper: VCSEL devices and packaging
- a. Dec 1998
 - b. Proceedings of SPIE, ISSN 0277-786X, 05/2003, Volume 3289, Issue 1
 - c. <http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=935769>

1999

- 47) Paper and Interviewed Article: Commercial VCSEL Manufacturing
- a. Apr 1999
 - b. Compound Semiconductor
- 48) Course (peer reviewed): "Optoelectronic devices and packaging: VCSEL and edge emitter technology"
- a. May 1999
 - b. IEEE Electronics and components technology conference; San Diego, California
 - c. <http://www.ectc.net>

2000

- 49) Invited Panel Session: Opto Electronic Integrated Circuits - More IC than OE?
- 5th Mar 2000
 - "The panel session focused on optical integration for communications. Other panel members included Brendan Hyland CEO of Kymata amongst others.
 - OSA Executive Forum: Photonics and Telecommunications: the tidal wave of the new millennium
 - <http://www.laserfocusworld.com/articles/2000/02/osa-executive-forum-at-ofc-2000.html>
- 50) Course: Optoelectronics Components and Modules for Datacom and Telecom
- May 2000
 - Optoelectronics components and modules for the Telecommunication industry and Datacom Networks are rapidly advancing in terms of speed, lower cost and design. The main objectives of this course are to review the current and future trends for active devices and packaging technology for discrete components and data network modules. The course will cover in detail the fundamental active III-V devices and components used today and review current trends in both III-V device technology and packaging for telecom and datacom applications.
 - Proceedings 50th Electronics Components and Technology Conference May 2000
 - <http://www.thierry-lequeu.fr/data/Ectc/ECTC2000/ECTC2000.pdf>
- 51) Invited Presentation and Abstract: An investor's perspective on optical interconnects
- 24th May 2000
 - The talk discusses the investor's perspective on optical interconnects from Intel Capital.
 - IEEE: Workshop on interconnections within high-speed digital systems
 - <http://www.oi-ieee.org/>
- 52) Invited Presentation: Optoelectronic Integration for Metro DWDM: Intel's perspective...
- 3rd Sep 2000
 - As part of the ECOC conference in Munich Germany, this workshop invited 9 speakers to discuss the future of optical networking in metropolitan environments.
 - Electronicast Europe
 - <http://www.electronicastconsultants.com>
- 53) Keynote Presentation: Optoelectronics Integration for Metro DWDM, Intel's Perspective
- 9th Oct 2000
 - Electronicast Corporations: Optical communications start-up and emerging companies conference
 - <http://www.electronicastconsultants.com>
- 54) Panel Session: Semiconductors to Optics
- 6th Nov 2000

- b. Representing Intel at the conference, the panel explored the reasons why Intel was investing into photonics, optics, and fiber optic communications. Panel moderator was Drew Lanza, VC Morgenthaler.
- c. JP Morgan communications components conference: the convergence of optical components and communications ICs
- d. <http://www.thefreelibrary.com/Endwave+Founder+and+EVP+To+Speak+at+JP+Morgan+Communications...-a067529552>

2001

- 55) Paper: Optical components and their role in optical networks
 - a. 2001
 - b. Electronic Components and Technology Conference, 2001. Proceedings., 51st
 - c. http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=927765&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxppls%2Fabs_all.jsp%3Farnumber%3D927765
- 56) Invited Presentation: "Starting a company and hitting the ground running"
 - a. 7th Feb 2001
 - b. Storm Ventures limited partner meeting
 - c. <http://www.stormventures.com>
- 57) Keynote Talk: Industry 'Optomism'
 - a. 30th Apr 2001
 - b. Electronicast; Fiber Optics for the next decade conference; 13th Annual Monterey conference <http://www.electronicastconsultants.com>
- 58) Keynote Talk: Next decade in fiber optic communications
 - a. 1st May 2001
 - b. Electronicast: 13th Annual Fiber Optics for the Next Decade Conference
 - c. <http://www.photonics.com/Article.aspx?AID=8916>
- 59) Panel session: Next decade in fiber optic communications
 - a. 2nd May 2001
 - b. Electroicast: 13th Annual Fiber Optics for the Next Decade Conference
 - c. <http://www.photonics.com/Article.aspx?AID=8916>
- 60) Paper: OEICs: commercialization at last
 - a. Jul 2001
 - b. Compound Semiconductor, vol. 7. no. 6, pp. 81-2, 85, July 2001
 - c. <http://www.compoundsemiconductor.net/csc/features-details.php?cat=features&id=11719>

- 61) Book chapter: "Optical sources: Light-emitting diodes and laser technology"
- Published 2002
 - "The Handbook includes chapters on all the major industry standards, quick reference tables, helpful appendices, plus a new glossary and list of acronyms. This practical handbook can stand alone or as a companion volume to DeCusatis: Fiber Optic Data Communication: Technological Advances and Trends (February 2002, ISBN: 0-12-207892-6), which was developed in tandem with this book.
 - Academic Press (1998, 2002); ISBN: 0-12-207892-6; Handbook of Fiber Optic Data Communication By Casimer DeCusatis
 - http://books.google.com/books?id=Rlb61Kkn18IC&printsec=frontcover&source=gb_s_ge_summary_r&cad=0#v=onepage&q&f=false
- 62) Book chapter: "Semiconductor laser and light emitting diode fabrication"
- Published 2002
 - "The Handbook includes chapters on all the major industry standards, quick reference tables, helpful appendices, plus a new glossary and list of acronyms. This practical handbook can stand alone or as a companion volume to DeCusatis: Fiber Optic Data Communication: Technological Advances and Trends (February 2002, ISBN: 0-12-207892-6), which was developed in tandem with this book.
 - Academic Press: Editor DeCusatis: Fiber Optic Data Communication: Technological Advances and Trends (February 2002, ISBN: 0-12-207892-6)
 - <http://books.google.com/books?id=Rlb61Kkn18IC&lpg=PP1&pg=PP1#v=onepage&q&f=false>
- 63) Keynote speech: "Business and Technical Perspectives for Optical Networking"
- 14th Jul 2002
 - PhoPack 2002 Stanford University
 - http://www.accessmylibrary.com/coms2/summary_0286-25792277_ITMhttp://books.google.com/books/about/LEOS_88.html?id=LUS0cQAACAAB
- 64) Interview Optcon (Japan), "Ignis Optics: Small is beautiful"
- 15th Aug 2002
 - Overview of Ignis Optics strategy for fiber optic transceivers with innovative optoelectronic devices and packaging (in Japanese).
 - Optcon volume 8, no 161, pp50-51
 - <http://magissuelist.nichigai.co.jp/detail?id=0000000098732>
- 65) Panel Session: An adventure into venture capital - lessons from silicon valley
- 12th Sep 2002
 - Evening forum discussion chaired by Professor Richard Harrison, Chair, with panel members Pitch Johnson (VC), Brendan Hyland (Nutrior Ventures), Jane

- Karwoski (All-hotels Ltd), and Colin Rutherford (Intelli Partners). Sponsored by Scottish Development International, University of Edinburgh, British Council
- 66) Invited Paper: Elegant cost-effective optical subsystems for next generation optical networks
- 13th Nov 2002
 - Electronicast: 4th Annual OADM and advanced photonics communication networks conference - market and technology trends, San Mateo, California
 - <http://www.electronicastconsultants.com/>

2004

- 67) Invited Paper (extended abstract) and Presentation: Automated commercial fabrication of wideband tunable lasers using ultra-high resolution e-beam lithography
- 27th Oct 2004
 - IoP/CS-MAX extended abstract at the Compound Semiconductor Manufacturing Expo, Monterey, California, pp92-94 in the technical digest.
 - <http://www.compoundsemiconductor.net>

2005

- 68) Book: Optoelectronic Markets 2005
- Jun 2005
 - Comprehensive market report and forecast of current optoelectronics markets, needs, technologies, and applications. This report forecasts the current state and direction of the optoelectronics industry.
 - OIDA
 - <http://www.oida.org/home/publications/oida-publication-report-library/>
- 69) Cover story/Interview: Does a foundry model add up for InP optoelectronics
- Jul 2005
 - Interview with Michael Hatcher from Compound Semiconductor magazine. Volume 11, Number 7, August 2005 pp 17-19
 - Compound Semiconductor: Three-fives and silicon heterostructures
 - <http://www.compoundsemiconductor.net>
- 70) Short Article: President's Letter to OIDA Membership
- Nov 2005

- b. OIDA Newsletter, quarterly from 2005-2009
 - c. http://www.wsr-ods.com/files/oidanews_0408.pdf
- 71) Invited talk: Worldwide Optoelectronic Trends and Economic Opportunities.
- a. 18th Nov 2005
 - b. UNCC 4th Annual symposium: UNC Charlotte Center for Optoelectronics and Optical Communications
 - c. <http://opticscenter.uncc.edu/node/275>

2006

- 72) Workshop: 100 Gb Ethernet: The Next Challenge for Communications Systems
- a. 1st Oct 2006
 - b. Workshop chairman and editor of the report: Abstract: The communications market is continuously evolving to provide better and cheaper services. These changes have led to the movement away from the traditional voice-switched networks to more data-centric packet networks. This report seeks to examine the next generation of Ethernet devices as we strain the technology limits at 100 Gb/s? How will datacom and telecom networks differ in their approaches? OIDA [http://www.oida.org/home/publications/oida_publication_report_library/100_gb_ethernet_the_next_challenge_for_communi_\(1\)/](http://www.oida.org/home/publications/oida_publication_report_library/100_gb_ethernet_the_next_challenge_for_communi_(1)/)
 - c.
- 73) Workshop: The Challenge for Indium Phosphide Photonic Development and the Optical Foundry
- a. 2006
 - b. "Workshop chairman and editor of the report.
 - c. Abstract: Indium Phosphide, InP, is a semiconductor material with properties that make it particularly suitable for optoelectronic devices. Optical communications requirements drove its initial development. Recently, the applications for InP semiconductor devices have broadened to include high-speed electronics and optical sensors. This report examines the current state of the InP device market and its future direction. Addresses challenges for a pure foundry play and the role for InP devices. Seeks to find the best ways to address the needs for InP device development in the U.S."
 - d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/the_challenge_for_indium_phosphide_photonic_develo/
- 74) Workshop: Nitride LED and Laser Technology and Its Impact on the Display, Medical, and Storage Industries
- a. 2006

- b. Workshop chairman and editor of the report:
 - c. Abstract: Since the development of p-type material in 1989, research in nitride emitter technology has developed rapidly over the last 15 years. This material system provided a new range of color applications that could be better utilized and with far better reliability than the II-VI material system. This report examines material systems and developments for short wavelength (green-ultraviolet) lasers and LEDs with techniques such as color-mixing and phosphor conversion.
 - d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/nitride_led_and_laser_technology_and_its_impact_on/
 - f.
- 75) Invited Article: A New Model for the Optoelectronic Indium-based Semiconductor Industry
- a. May 2006
 - b. OSA: Optics and Photonics News
 - c. <http://www.osa-opn.org/Content/ViewFile.aspx?id=10456>
- 76) Book: Worldwide Optoelectronics Markets and Trends 2006
- a. Jun 2006
 - b. Comprehensive market report and forecast of current optoelectronics markets, needs, technologies, and applications. This report forecasts the current state and direction of the optoelectronics industry.
 - c. OIDA, 431 pages
 - d. http://www.oida.org/home/publications/oida_publication_report_library/2006_global_optoelectronics_industry_market_report/
- 77) Workshop: High Power Diode Laser Sources and Their Impact on Industrial, Medical, and Military Laser Industries
- a. 1st Jul 2006
 - b. Workshop chairman and editor of the report:
 - c. Abstract: High power semiconductor laser diodes are used in several different market segments today. The technology continues to advance and improvements in efficiency and power are reported each year. Semiconductor laser diodes are used either directly or indirectly to enable new applications or as a replacement for older technology approaches. This report examines practical implementations and limitations for lasers in the 100 W to 100 kW range and roadmaps and developments anticipated over the next five years.
 - d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/high_power_diode_laser_sources_and_their_impact_on/
- 78) Workshop: Biophotonic Sensors and Smart Fiber Optic Sensor Networks
- a. 1st Aug 2006
 - b. Workshop chairman and editor of the report:
 - c. Abstract: This roadmap report examines biophotonic sensor opportunities from many perspectives including; government, industrial, university and venture

capital. The markets, technologies, commercialization, and roadmap trends are presented in addition to promising areas for R & D.

d. OIDA

e. http://www.oida.org/home/publications/oida_publication_report_library/biophotonic_sensors_and_smart_fiber_optic_sensor_n/

79) Workshop: Wide Area Surveillance

a. 1st Oct 2006

b. Workshop chairman and editor of the report:

c. Abstract: This report examines wide area surveillance of pipelines and other strategic infrastructure as it is rapidly becoming an important issue on a worldwide basis. The increasing need for surveillance for both homeland security as well as defense applications should make this commercially attractive to both the defense as well as to commercial industry. (Report is 62 pages followed by hard copies of presentations from the forum.)

d. OIDA

e. http://www.oida.org/home/publications/oida_publication_report_library/wide_area_surveillance/

80) Invited Talk: OIDA optoelectronics markets, technology and opportunities for optofluidics

a. 20th Oct 2006

b. Organized by the DARPA center for optofluidics: translational research and commercialization workshop.

c. DARPA Optofluidics industry forum, UCSD San Diego, CA

d. <http://www.biophot.caltech.edu/optofluidics/>

81) Invited talk: Global optoelectronics technology roadmaps and trends

a. 27th Oct 2006

b. UNCC 5th Annual Symposium: UNC Charlotte Center for Optoelectronics and Optical Communications

c. <http://opticscenter.uncc.edu/node/268>

82) Workshop: Artificial vision systems

a. 1st Dec 2006

b. Workshop chairman and editor of the report:

c. Abstract: The ability to identify objects of interest and emerging threats around a vehicle in real time or by a warfighter looking for threats in a large field of view is currently severely hampered by the limitations of current algorithms and processing platforms. There have been recent advances in several technology areas, which if combined intelligently could solve this hard problem in enhancing situational awareness cost effectively. This report looks at the issues surrounding automated surveillance systems specifically looking at enhanced binoculars and convoy vehicle automated protection systems.

d. OIDA

e. http://www.oida.org/home/publications/oida_publication_report_library/artificial_vision_systems/

- 83) Keynote address: Global perspectives in optoelectronics and photonics
- a. 6th Dec 2006
 - b. Photonics 21: European Union's 7th Framework Program Key Photonics Platform
 - c. http://www.photonics21.org/downloads/download_presentations.php

2007

- 84) Workshop: Micropackaging for the Next Generation of Optical and Electrical Components
- a. 2007
 - b. Workshop chairman and editor of the report:
 - c. Abstract: Optical components are ubiquitous. Applications that use them include DVD players, audio devices, cell phones, re-writable drives, projection displays, and communication devices. This report concentrates on the role of micropackaging for the for next generation fiber optic components with an eye towards lower cost and higher volume.
 - d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/micropackaging_for_the_next_generation_of_optical/
- 85) Workshop: Silicon Photonics: Challenges and Future, 2007
- a. 2007
 - b. Workshop chairman and editor of the report:
 - c. Abstract: Copper interconnects are currently used extensively within the data center environment. Fiber optic technology is used as a connectivity solution when higher performance is required and the cost differential compared to a copper solution is affordable. Fiber optic technology offers several key advantages over copper solutions for data transmission. This report looks at silicon photonics as a potential optical interconnect solution and addresses the issues and technology paths being pursued.
 - d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/silicon_photonics_challenges_and_future_2007/
- 86) Workshop: Photonic Sensors Roadmapping Report, 2007
- a. 2007
 - b. Workshop chairman and editor of the report:
 - c. Abstract: This OIDA workshop report examines application specific sensor needs for both the government and the private sector with an emphasis on the oil and gas market, sensing function integration, cost reduction opportunities, and barriers and competing technologies.

- d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/photonic_sensors_roadmapping_report_2007/
- 87) Paper: Fiber optic sensing technology: emerging markets and trends
- a. 2007
 - b. Third European Workshop on Optical Fibre Sensors.
 - c. Edited by Cutolo, Antonello; Culshaw, Brian; Lopez-Higuera, Joshua Miguel.
 - d. Proceedings of the SPIE, Volume 6619, pp. 661902 (2007). (SPIE Homepage)
 - e. <http://adsabs.harvard.edu/abs/2007SPIE.6619E...2H>
- 88) Article: "Optoelectronics Technology: New and Exciting Markets in Consumer and Entertainment"
- a. 10th Jan 2007
 - b. "The total optoelectronics components and enabled products grew 20% in 2005 to \$364 billion, from \$304 billion in 2004. Components grew 17% in 2005 to \$104 billion, from \$89 billion in 2004. When flat panel displays are excluded as components, components grew 10% in 2005 to \$30 billion, from \$27 billion in the previous year. Enabled products grew 21% to \$260 billion in 2005, from \$215 billion in 2004.
 - c. IEEE CPMT Santa Clara
 - d. <http://www.cpmt.org/scv/meetings/cpmt0701.html>
- 89) Abstract and conference invited talk: The case for a photonics foundry in USA
- a. 27th April 2007
 - b. European Conference on Integrated Optics (2007): Towards foundries for photonic ICs
 - c. <http://www.epixnet.org/index.php?id=393>
- 90) Paper: Optoelectronics Roadmap OIDA-iNEMI
- a. May 2007
 - b. IEEE Packaging and Assembly
- 91) Workshop: 100 Gbit Interconnects and Above: The Need for Speed
- a. 1st May 2007
 - b. Workshop chairman and editor of the report:
 - c. Abstract: The electronic society we live in today is seeing increased demand for data transfer, internet downloads, online applications, video sharing and storage. The electronic world of banks, companies, universities and governments require large secure datacenters connected to secure networks. This continuously drives for the development of more powerful servers and computer systems. This report examines needs and motivations for optical interconnect implementation. Looks at the applications, history, market drivers, and future issues that affect this crossover.
 - d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/100_gb_ethernet_the_next_challenge_for_communicati/
- 92) Book: 2007 Global Optoelectronics Industry Market Report and Forecast

- a. Jun 2007
 - b. Comprehensive market report and forecast of current optoelectronics markets, needs, technologies, and applications. This report forecasts the current state and direction of the optoelectronics industry.
 - c. OIDA, 517 pages
 - d. http://www.oida.org/home/publications/oida_publication_report_library/2007_global_optoelectronics_industry_market_report/
- 93) Paper: Growing at light speed
- a. The article discusses the significance of optoelectronics in high technology manufacturing industries. Optoelectronics components are being used in the manufacturing cameras of mobile phones, plasma display panel TVs and LCD TVs, among others. Since its application allows product differentiation and innovation, it has spurred growth in segments such as the consumer/entertainment, computer and communications industries. The article also discusses the differences in the material and processing equipment such as silicon photonics.
 - b. Sep 2007
 - c. IEEE Circuits Assembly; Sep 2007, Vol. 18 Issue 9, p44
 - d. <http://www.thefreelibrary.com/Growing+at+light+speed%3a+after+a+false+start%2c+OE+is+fast+becoming+a...-a0168812805>
- 94) Keynote/special invited talk: "10 Grand Challenges in Photonics"
- a. 31st Oct 2007
 - b. Sixth annual symposium UNCC Optoelectronics Center
 - c. <http://opticscenter.uncc.edu/node/265>

2008

- 95) Workshop: Perspectives on the Optoelectronics Industry: Manufacturing in the 21st Century, 2008
- a. 2008
 - b. Workshop chairman and editor of the report:
 - c. Abstract: This report provides insight and perspectives by senior-level representatives from industry on global trade and manufacturing practices in the field of optoelectronics. Three areas examined are: 1) Can automation or optical integration relieve the momentum to outsource and off-shore manufacturing from North America? 2) The supply chain and the economics of manufacturing in the U.S., Europe, and Asia, and 3) The implications of offshore manufacturing on both the U.S. defense and commercial market sectors within the different fields of optoelectronics.

- d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/perspectives_on_the_optoelectronics_industry_manuf/
- 96) Workshop: Perspectives on the Optoelectronics Industry: Innovation, 2008
- a. 2008
 - b. Workshop chairman and editor of the report: Abstract: This report documents some of the issues raised at the Optoelectronics Industry Development Association (OIDA) forum and provides a review on the critical issue of innovation in the U.S. and the impact it has on future American competitiveness and technology leadership. This report looks at innovation and R&D from many perspectives: global, business, university, government funding agencies.
 - c. OIDA
 - d. http://www.oida.org/home/publications/oida_publication_report_library/perspectives_on_the_optoelectronics_industry_innov/
- 97) Workshop: Perspectives on the Optoelectronics Industry, 2008
- a. 2008
 - b. Workshop chairman and editor of the report:
 - c. Abstract: The United States is falling behind in the manufacturing, packaging, and assembling of optoelectronics products. Innovating technology may also be imperiled. This report is the result of the first of three optoelectronic forums sponsored by the Defense Advanced Research Projects Agency (DARPA). This report details the trends, findings, and directions for optoelectronics in each of these market applications. Included in the first chapter of this report is the global optoelectronics summary that was compiled by OIDA in 2007.
 - d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/perspectives_on_the_optoelectronics_industry_2008/
- 98) Workshop: Future Optical Communication Systems, 2008
- a. 2008
 - b. Workshop chairman and editor of the report:
 - c. Abstract: This report examines future optical communication needs and technologies. Topics include: Networks, Core, Metro, and Access Technology, photonic integration, and markets.
 - d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/future_optical_communication_systems_2008/
- 99) Book chapter: Being an Intrapreneur and Entrepreneur in the Optoelectronics Industry
- a. 2008
 - b. This book provides actual entrepreneurial stories giving insight into the pitfalls and successes one might find in starting or even continuing with a small high-tech business. Insights into innovative, speculative, and (largely) successful new ventures, as experienced by those who went through the process, are complemented by comments and observations from others in the field including

researchers, economists, investors, regional development agencies, technology transfer organizations, and universities. The book is recommended to entrepreneurs in all high technology disciplines and in particular for students and early career professionals. It can be also useful for undergraduate and postgraduate courses in entrepreneurship, which many institutions are currently introducing, and to those who are interested in how a high-tech business might develop.

- c. SPIE: Engineering a High-Tech Business: Entrepreneurial Experiences and Insights By Jos   Miguel L  pez-Higuera, B. Culshaw (Editors) ISBN 978-0-8194-7180-2
- d. <http://books.google.com/books?hl=en&lr=&id=wXV9tffoGeYC&oi=fnd&pg=PR9&dq=michael+lebbby&ots=cYEwXIHMDc&sig=KlCtj2ZDgbOYEhnqKdHiMo6SdzA#v=onepage&q=michael%20lebbby&f=false>

2009

- 100) Workshop: Green Photonics: The Role of Optoelectronics in a Sustainable Future, 2009
 - a. 2009
 - b. Workshop chairman and editor of the report:
 - c. Abstract: This report explores the optoelectronics expectations for green photonics technology, and forecasts the associated markets through 2020. The cultural impact for a green, clean, and energy efficient lifestyle is just beginning. Over the next decade, many innovative new products will emerge in a variety of industries that will better define and demonstrate green photonics technology. It is clear to many that a broad range of products and services that the economy will utilize over the next decade will contain optoelectronics (interchangeable with the term photonics), either as key components or as components that enable better and more efficient systems.
 - d. OIDA
 - e. http://www.oida.org/home/publications/oida_publication_report_library/green_photonics_the_role_of_optoelectronics_in_a_s/
- 101) Conference: Optimism: "Powering the green revolution through photonics"
 - a. 4th Jan 2009
 - b. "Co-chairman of Optimism conference with Pennwell.
 - c. OIDA and Pennwell (Laser Focus World)
 - d. <http://www.laserfocusworld.com/articles/print/volume-45/issue-4/world-news/conference-preview-optimism-to-emphasize-lsquoogreenrsquo-growth.html>
- 102) Invited talk, short abstract, and session chairman: Energy Efficient Photonics

- a. 19th Mar 2009
 - b. Summary: Green photonics initiatives: The role of optoelectronics in a sustainable future...
 - c. European Commission: High Level Event on ICT for Energy Efficiency
 - d. http://ec.europa.eu/information_society/events/cf/ee09/item-display.cfm?id=2174
- 103) Trial & Cross: Testimony before the US-China economic and security review commission on the optoelectronics industry
- a. 24th Mar 2009
 - b. "Expert witness and testimony on Capitol Hill
 - c. Final oral comments: In preparing this testimony, many people I contacted stressed the importance of decisive action by the U.S. government and industry now. Optoelectronics sits at the intersection of multiple technical disciplines. U.S. universities and industry are particularly adept at bringing diverse people together to work on complex problems. We have, by the nature of our inherent diversity, an advantage. What for many presents a challenge, for us comes naturally. Thank you for this opportunity to present our industry's perspective. "
 - d. United States China Commission
 - e. http://www.uscc.gov/hearings/2009hearings/written_testimonies/09_03_24_wrts/09_03_24_lebby_statement.pdf
- 104) Report: Photonics industry-university collaborations (PICs)
- a. 1st Jun 2009
 - b. OIDA Final Technical Report
 - c. <http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA502737>
- 105) Paper: Green photonics technology and markets
- a. Sep 2009
 - b. Green photonics technology will open up opportunities over the next decade for new and creative products to be designed as the interest in a green, clean and energy efficient lifestyle continues to grow. This overview forecasts the optoelectronics expectations for green photonics technology and associated markets over the next decade and explores just a few of the exciting opportunities from green photonics technology.
 - c. Electronics Letters, Vol 45, issue 20
 - d. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=5270369&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F2220%2F5270368%2F05270369.pdf%3Farnumber%3D5270369>
- 106) Paper: Photonic Integration: what is the Holy Grail?
- a. 14th Oct 2009
 - b. Compound Semiconductor
 - c. <http://compoundsemiconductor.net/csc/features-details.php?id=40435>
- 107) Keynote talk: Global optoelectronics and green photonics trends
- a. 28th Oct 2009
 - b. UNCC 8th Annual Symposium: Optoelectronics Center

- c. <http://opticscenter.uncc.edu/node/255>
- 108) Keynote talk and abstract: Is this the rise of green photonics?
 - a. Dec 2009
 - b. ICFO (Institut de Ciencies Fotoniques) Barcelona, Spain
 - c. <http://www.icfo.es/images/news/ICFO%20CLP%20DAY%20Program.pdf>
- 109) Book: 2009 Global Optoelectronics Industry Market Report and Forecast
 - a. Dec 2009
 - b. Comprehensive market report and forecast of current optoelectronics markets, needs, technologies, and applications. This report forecasts the current state and direction of the optoelectronics industry.
 - c. OIDA, 545 pages
 - d. http://www.oida.org/home/publications/oida_publication_report_library/2009_global_optoelectronics_industry_market_report/
- 110) Video presentation: Living at the speed of light
 - a. 10th Dec 2009
 - b. Living at the speed of light, hosted by renown physicist Michael Lebby, takes us on a fast paced fly through of the many facets of photonics and how the use of light touches the many aspects of our lives
 - c. National Research Council: Canadian Photonics Fabrication Centre
 - d. <http://www.youtube.com/watch?v=t8EB-1-1irY>
- 111) Book chapter: Packaging of Optical Components and Systems
 - a. 27th Dec 2009
 - b. "In this article, several types of semiconductor optical components are introduced, and packaging of optical components and systems will be discussed. Specifically, three common types of optical sources will be addressed: light emitting diodes (LED), edge-emitting semiconductor lasers, and vertical cavity surface emitting lasers (VCSEL).
 - c. Wiley Encyclopedia of Electrical and Electronics Engineering; DOI: 10.1002/047134608X.W2106; originally published in 1999, Vol 15, pp 499-516; John G Webster (Editor)
 - d. <http://onlinelibrary.wiley.com/doi/10.1002/047134608X.W2106/abstract>

2010

- 112) Workshop: Fabrication Challenges and Opportunities in Photonics, 2010
 - a. 2010
 - b. Workshop chairman and editor of the report: Abstract: This report examines different operational models employed by industry (fabless, fab-lite, pure play

foundry and vertically integrated companies), and the role of governments in stimulating the growth of the photonics industry.

- c. OIDA
 - d. http://www.oida.org/home/publications/oida_publication_report_library/fabrication_challenges_and_opportunities_in_photon/
- 113) Video and presentation: Green Photonics: Will it Change our Lives over the Next Decade?
- a. April 2010
 - b. Photonics is growing to enable new green technologies and products. Photonics already has a large presence in various modules and components with opportunities to expand to home displays, solar cells, lighting, and various consumer applications. The global optoelectronics industry has a strong outlook for growth in the near future, with even faster growth in green photonics. Green photonics can help reduce greenhouse gas emissions, generate or conserve energy, reduce pollution, and improve human health.
 - c. University of California, Santa Barbara: Institute of Energy Efficiency
 - d. <http://iee.ucsb.edu/node/1024>
- 114) Conference and workshop: 3rd Annual Green Photonics Forum (OIDA Green 2010)
- a. 10th Jun 2010
 - b. Conference chairman: OIDA's innovative green photonics forums have become a focal point for photonics and optics in the area of sustainable energy. The annual forum on green photonics, brings together key players involved in developing the technical and business roles of photonics in building a more sustainable and renewable future. Efficiency, monitoring, and energy generation are areas where photonics technology will play a key role and the photonics industry will deliver solutions.
 - c. OIDA
 - d. <http://www.clocate.com/conference/3rd-Annual-Green-Photonics-Forum-OIDA-Green-2010/4045/>
- 115) Paper: Silicon light emitting device based on rare earth oxide superlattice
- a. Sep 2010
 - b. 7th IEEE International conference on Group IV photonics, Beijing China
 - c. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=5643407&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F5623516%2F5643317%2F05643407.pdf%3Farnumber%3D5643407>

- 116) Paper: Study of the Structural and Thermal Properties of Single Crystalline Epitaxial Rare-Earth-Metal Oxide Layers Grown on Si(111)
 - a. 2011
 - b. ECS Transactions 16, 161 (2011)
 - c. <http://ecst.ecsdl.org/content/41/3/161>
- 117) Webinar and presentation
 - a. 29th Mar 2011
 - b. "The future of photonics webinar and presentation: The Future of Photonics: Three Perspectives brings together three expert viewpoints on the future of the photonics industry (Michael Lebby will be the expert on market trends and photonic integrated circuits (PICs)). You will learn: global optoelectronics market outlook through 2021 trends in photonic integrated circuits over the next two decades."
 - c. Photonics Media
 - d. <http://www.photonics.com/Webinar.aspx?WebinarID=7>
- 118) Keynote invited speech: Green Photonics and GaN-on-Si for LEDs and Ge-on-Si for high Efficiency Multi-junction for PVs
 - a. Dec 2011
 - b. Conference proceedings: High Capacity Optical Networks and Enabling Technologies (HONET), 2011
 - c. <http://honet.uncc.edu/archive/honet11/speakers.htm>

2012

- 119) Paper: Structural and Thermal Properties of Single Crystalline Epitaxial Gd₂O₃ and Er₂O₃ Grown on Si(111)
 - a. 2012
 - b. ECS Journal of Solid State Science and Technology 1, N24 (2012)
 - c. <http://jss.ecsdl.org/content/1/2/N24.full.pdf+html>
- 120) Paper: Epitaxial Si, SiGe and Ge on binary and ternary rare earth oxide buffers
 - a. 2012
 - b. Phys. Status Solidi C 9, 2031 (2012)
 - c. <http://onlinelibrary.wiley.com/doi/10.1002/pssc.201200255/abstract>
- 121) Paper: Integrated high reflectivity silicon substrates for GaN LEDs
 - a. 13th Jan 2012
 - b. Volume 9, Issue 3-4, pages 814-817, March 2012, physica status solidi (c)
 - c. <http://onlinelibrary.wiley.com/doi/10.1002/pssc.201100393/abstract>
- 122) Paper: Integrated high reflectivity silicon substrates for GaN LEDs
 - a. 13th Jan 2012

- b. "Conference Publication: ICNS-9 "Contributed Article Integrated high reflectivity silicon substrates for GaN LEDs
 - c. F. Erdem Arkun*, Rytis Dargis, Robin Smith, David Williams, Andrew Clark, Michael Lebby
 - d. Article first published online: 13 JAN 2012" ICNS-9 "Contributed Article Integrated high reflectivity silicon substrates for GaN LEDs
 - e. <http://onlinelibrary.wiley.com/doi/10.1002/pssc.201100393/abstract>
- 123) Paper: Rare-earth-metal oxide buffer for epitaxial growth of single crystal GeSi and Ge on Si(111)
- a. 1st Mar 2012
 - b. Conference and journal publication."Rare-earth-metal oxide buffer for epitaxial growth of single crystal GeSi and Ge on Si(111)"
 - c. With publication details: 28th North American Molecular Beam Epitaxy Conference, Published by AVS through the American Institute of Physics, 2012 ISBN 978-0-9836933-0-7 ISSN: 2166-27646 J.Vac.Sci.Technol B 30(2), Mar/Apr 2012 pp02B110-1 to pp-3B110-6
 - d. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=6118290&contentType=Journals+%26+Magazines>
- 124) Paper: Scalable virtual Ge templates for III-V integration on Si wafers
- a. 18th April 2012
 - b. AIP Conference Proceedings / Volume 1477 / CONCENTRATOR SOLAR CELLS, CELL ASSEMBLIES AND RELATED MATERIALS
 - c. http://proceedings.aip.org/resource/2/apcpcs/1477/1/36_1?bypassSSO=1
- 125) Paper and talk: Engineering of the Interface Between Silicon and Rare-Earth Oxide Buffer for GaN growth
- a. Sept 2012
 - b. ECS Meeting Oct 2013, San Francisco, USA
 - c. http://scholar.googleusercontent.com/scholar?q=cache:l3-oHWxNDzwJ:scholar.google.com/+%22michael+lebbby%22&hl=en&as_sdt=1,5&as_ylo=2013&as_vis=1
- 126) Paper: Scalable GaN-on-Silicon using rare earth oxide buffer layers
- a. 9th Oct 2012
 - b. ECS Trans 2013 volume 50, issue 9, 1065-1071
 - c. <http://ma.ecsdl.org/content/MA2012-02/30/2538.short>

2013

- 127) Paper: Epitaxial Si and Gd₂O₃ Heterostructures - Distributed Bragg Reflectors with Stress Management Function for GaN on Si Light Emitting Devices

- a. 2013
 - b. ECS Trans 2013 volume 50, issue 4, 47-52
 - c. <http://ecst.ecsdl.org/content/50/4/47.short>
- 128) Article: OPTICAL MATERIALS: 'On-silicon' engineered substrates speed photonic device development
- a. 1st Apr 2013
 - b. Laser Focus World
 - c. <http://www.laserfocusworld.com/articles/print/volume-49/issue-04/features/optical-materials---on-silicon--engineered-substrates-speed-phot.html>
- 129) Paper & Poster: 100Gb/s Multi-guide vertical integration transmitter PIC in InP for fiber-optics interconnects
- a. 24th Sep 2013
 - b. Sasa Ristic and Michael Lebby, Valery Tolstikhin, and Kirill Pimenov,
 - c. ECOC 2013
 - d. <http://www.ecoc2013.org/sc2.html>
- 130) Paper: Epitaxial Si and Gd2O3 Heterostructures - Distributed Bragg Reflectors with Stress Management Function for GaN on Si Light Emitting Devices
- a. 1st Oct 2012
 - b. ECS J. Solid State Sci. Technol. 1, 246 (2012)
 - c. <http://jss.ecsdl.org/content/1/5/P246.full>
- 131) Growth of GaN by MOCVD on rare earth oxide on Si(111)
- a. 31st Oct 2013
 - b. ECS Transactions, 58, 455 (2013)
 - c. <http://ecst.ecsdl.org/content/58/4/455.short>
- 132) Invited talk/plenary: Next generation ICs using photonics integration
- a. 10th Dec 2013
 - b. Talk that reviews OneChip Photonics technology and in general PICs, OEICs, Silicon photonics, and how these technologies play into datacenters (data centers) for client side high speed 100G fiber (fibre) optic transceiver interconnects and cabling.
 - c. IQE Capital markets day, Sky Pavillion, Rothschild Building, London, UK
 - d. <http://www.euroinvestor.com/news/2013/12/10/iqe-plc-capital-markets-day/12617916>
- 133) Poster paper: A versatile InP OEIC (PIC) platform enabling 100G+ coherent receiver and client-side transceiver engines
- a. 12th Nov 2013
 - b. Poster paper describing OneChip's latest results in coherent receivers, LR4 optical engines, and PSM4 optical engines.
 - c. Silicon Photonics Workshop, Southampton University, UK
 - d. http://www.orc.soton.ac.uk/UKSP_presents.html
- 134) Talk and panel session: Approaches for combining 3-5 and silicon, add functionality to Si photonics, heterogeneous versus hybrid integration, introduction of photonic platforms

- a. 5th Dec 2013
 - b. Short presentation on PICs, OEICs, Si photonics, and combinations of these technologies from a revenue, investment, application and technology standpoint.
 - c. EPIC workshop: Meet or eat? collaboration and/or competition in photonic integrated circuits (PICs)
 - d. <http://epic-assoc.com/contact-us/?at=94>
- 135) Invited talk: Feedback USA/International related events
- a. 5th Dec 2013
 - b. Feedback on the subject of InP PICs, OEICs, and silicon photonics from workshops and related international events from around the globe.
 - c. EPIC workshop: Meet or eat? Collaboration and/or competition in Photonic Integrated Circuits (PICs)?
 - d. <http://epic-assoc.com/contact-us/?at=94>

2014

- 136) Invited talk/plenary: High-Performance Datacenter Platform: Using InP for Silicon Photonics
- a. 8th Jan 2014
 - b. IEEE-CPMT/Photonics Society local chapter meeting, Santa Clara, California
 - c. <http://www.cpmpt.org/scv/meetings/cpmt1401.html>
- 137) Invited talk/Panel session “Optical interconnect in datacenters”
- a. 18th Mar 2014
 - b. "The 1st Optical Interconnect in Data Centers Symposium takes place on the 18th and 19th of March 2014 in Berlin/ Germany.
 - c. It is focused on high-performance, low-energy and low-cost and small-size optical interconnects across the different hierarchy levels in data center and high-performance computing systems: on-board, board-to-board and rack-to-rack.
 - d. EPIC: Symposium on optical interconnect in datacenters
 - e. <http://www.phoxtrot.eu/1st-optical-interconnect-in-data-centers-symposium/>
- 138) Keynote talk: Photonic integration in InP: A regrowth-free platform for fabless manufacturing model
- a. 19th March 2014
 - b. CS International Conference Frankfurt, March 17th-20th 2014
 - c. <http://cs-international.net/agenda.php>
- 139) Invited talk/Panel session: InP based photonics integration platform for datacenter and coherent communications
- a. 2nd April 2014

- b. Invited talk/panel session on the future of integrated photonics. Discussion was on both InP and silicon photonics technologies over the next decade.
 - c. Workshop on the future of Integrated Photonics organized by the Netherlands Office for Science & Technology is pleased to invite you to a workshop, occurring in conjunction with the upcoming Photonics West conference
 - d. <http://www.hollandinthevalley.com/panel-discussion-on-the-future-of-integrated-photonics/>
- 140) Invited talk and abstract: Coherent Receiver Chip for 100G DP-QPSK
 - a. 30th April 2014
 - b. SIOE (Semiconductor and integrated optoelectronics) Conference, Cardiff, Wales, UK 29th April-1st May 2014, Institute of Physics
 - c. <http://www.astro.cardiff.ac.uk/research/cmp/events/resources/Sioeprogramme14final.pdf>
- 141) Invited talk/keynote lecture: Compound semiconductors driving photonics technologies to become the future for high-speed communications through integration, performance, and sustainability
 - a. 12th Jun 2014
 - b. Glyndwr University, Wales, UK
 - c. <http://www.glyndwr.ac.uk/en/AboutGlyndwrUniversity/Newsandmediacentre/Newsarchive/PressReleases2014/UniWeek/>
- 142) Invited Talk/Panel session: EPIC technology workshop on Photonic Integrated Circuits (PIC) packaging standardization
 - a. 18th Jun 2014
 - b. EPIC
 - c. <http://epic-assoc.com/contact-us/?at=94>
- 143) Invited talk: Compound Semiconductors (CS) driving photonics
 - a. 11th June 2014
 - b. Invited presentation for Welsh Gvt and commercial industry in epitaxial growth. The talk covered photonics: global markets, green photonics, photonics technology sectors (lighting, solar, displays, sensors, communications), integrated photonics and silicon photonics. Commercial industry invite by International Quantum Epitaxy (IQE)
 - c. Growth and application of epitaxial heterostructures with polymorphous rare earth oxides
 - d. Journal of Crystal Growth
 - e. <http://www.sciencedirect.com/science/article/pii/S0022024812009487>
- 144) Invited presentation for Day of Photonics at Glyndwr University: Photonics - markets, applications, integrated, next generation IC
 - a. 21st Oct 2014
 - b. Invited presentation/lecture on photonics at the Glyndwr University.
 - c. Welsh Optoelectronic Forum (WOF)
 - d. http://www.wof.org.uk/home.php?page_id=4&event_id=317
- 145) Invited talk and moderator: Integrated photonics pilot lines

- a. 14th Nov 2014
- b. "Photonics Pilot Line Workshop 14 November 2014 - Brussels, Belgium
- c. European Commission and Photonics21
- d. <http://www.photonics21.org/download/Events/DraftagendaPhotonicsPilotLineworkshop-Website.pdf>

2015

- 146) Invited talk: Integrated photonics roadmap synthesis
 - a. 7th May 2015
 - b. Integrated Photonics Institute for Manufacturing Innovation (IP-IMI) site visit technical review:
 - c. The University of Southern California's (USC) Information Sciences Institute (ISI) is leading an effort with partner universities at the University of California-Los Angeles (UCLA), the University of California-Berkeley (UCB), the University of California-San Diego (UCSD), Arizona State University, the University of New Mexico, and the Ohio State University, as well as numerous industry partners, to develop the only California-based and led proposal to compete for the IP-IMI award. If successful, the proposal will receive a federal award of up to \$110 million over five years. A successful proposal requires 100 percent or more in matching funds (cash or in-kind) from state and local governments and from industry partners.
 - d. IPI-CDMS (Integrated Photonics Institute and Center for Design and Manufacturing Services)
 - e. <http://www.isi.edu/news/story/531784>
- 147) Invited talk and Chair panel session: EPIC workshop on photonic integrated circuits; "Global integrated photonics update and roadmaps"
 - a. 9th Jun 2015
 - b. "Invited talk: Global integrated photonics update and roadmaps
 - c. Panel Session: Integrated photonics foundry status
 - d. EPIC trade association, Europe
 - e. <http://www.epic-assoc.com/epic-workshop-on-photonic-integrated-circuits/>
- 148) Keynote talk and invited abstract: "Integrated photonics as a vehicle for the next generation IC"
 - a. 9th Sep 2015
 - b. Internet Technology Applications (ITA) ITA-15 conference Wrexham, Wales, UK 8-11th Sept 2015
 - c. <http://www.ital5.net/keynote-speaker/>

- 149) Press interview: "Building Big Business with the Next Generation Integrated Circuits!"
- 15th Sep 2015
 - "Insights from Michael Lebby, CEO OneChip Photonics Corporation, the keynote speaker at the Photonics Integration Conference
 - Photonics Integration Conference, organized by Jakajima, Netherlands
 - <http://www.phiconference.com/photonics/building-big-business-with-the-next-generation-integrated-circuits/>
- 150) Project advisor: European Commission ICT-28-2015 Cross-Cutting ICT KETs: Innovation Action (b) Pilot line for OLEDs on flexible substrates
- 20th Sept 2015
 - European Commission
 - <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/916-ict-28-2015.html>
- 151) Project advisor: European Commission ICT-28-2015 Cross-Cutting ICT KETs: Innovation Action (b) Pilot line for analytical mid-infrared (MIR) micro-sensors
- 22nd Sep 2015
 - European Commission
 - <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/916-ict-28-2015.html>
- 152) Keynote talk and abstract: "PIC the next generation IC..."
- 23rd Sep 2015
 - Photonic Integration Conference, organized by Jakajima, Netherlands
 - <http://www.phiconference.com/program/>
- 153) Project advisor: European Commission ICT-28-2015 Cross-Cutting ICT KETs: Innovation Action (b) Pilot line for PIC fabrication on III-V and/or dielectric based platforms for PICs (Photonic Integrated Circuits)
- 24th Sep 2015
 - European Commission
 - <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/916-ict-28-2015.html>
- 154) Session organizer/Committee member: Market Focus at ECOC exhibit 2015
- 28th Sep 2015
 - Session organizer/Committee member: Market Focus at ECOC exhibit 2015 with sessions in broadband access, datacentres, service provider optical transmission, network agility/SDN, photonics integration and packet optical transport. Nexus Business Media Ltd
 - <http://webcache.googleusercontent.com/search?q=cache:Qb68vjzhV5IJ:www.ecocexhibition.com/visitorhome/marketfocus2015/cfs+&cd=1&hl=en&ct=clnk&gl=us&client=safari>

2016

- 155) Reviewer: European Commission ICT-29-2016: Photonics KET 2016 (section a(i) Biophotonics: advanced imaging for in-depth disease diagnosis)
 - a. 10th May 2016
 - b. European Commission
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html>
- 156) Reviewer: European Commission ICT-29-2016: Photonics KET 2016 (a(iii) Pervasive high-specificity and high-sensitivity sensing for a safer environment)
 - a. 12th May 2016
 - b. European Commission
- 157) Reviewer: European Commission ICT-29-2016 Photonics KET (b) Innovation Actions (i) Application driven core photonic devices integrated in systems.
 - a. 14th May 2016
 - b. European Commission
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html>
- 158) European Commission Reviewer: European Commission ICT-29-2016 Photonics KET (b) Innovation Actions (ii) Pilot line for assembly and packaging
 - a. 15th May 2016
 - b. European Commission
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html>
 - d. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html>
- 159) Invited Talk: Annual Shareholder Meeting 2016 - Market Perspective LWLG Polymer Photonics vs Legacy Devices
 - a. 20th May 2016
 - b. Presentation to investor group at Lightwave Logic's Annual Shareholder Meeting Lightwave Logic
 - c. <http://lightwavelogic.com/company-updates/>
- 160) Technical presentation for Lightwave Logic Inc., at the Annual Shareholder Meeting (ASM).
 - a. 20th May 2016
 - b. Lightwave logic Inc., Boulder, Colorado.
 - c. Annual shareholder meeting for Lightwave Logic Inc., with live presentation with live Q&A from investors
- 161) Invited Presentation and abstract: "High-Performance Polymer Photonics for Next-Generation Photonic Integrated Circuits"
 - a. 3rd Oct 2016

- b. ECOC Market Focus by ECOC Exhibition
 - c. <http://www.ecocexhibition.com/marketfocus>
- 162) Video Interview: ECOC Market Focus on Datacenters and emerging new PIC technologies that include silicon and polymer photonics
 - a. 3rd Oct 2016
 - b. Video taped interview by ECOC Exhibition Market Focus on Datacenters and emerging new PIC technologies that include polymer photonics.
 - c. ECOC Exhibition
 - d. <http://www.ecocexhibition.com/interviews2016>
- 163) Panel session: European Commission ICT-29-2016: Photonics KET 2016 (section a(ii) Breakthrough in miniaturization of SSL light engines and systems); comment on industry and academic technology.
 - a. 5th Nov 2016
 - b. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html>
- 164) Reviewer: European Commission ICT-29-2016: Photonics KET 2016 (section a(ii) Breakthrough in miniaturization of SSL light engines and systems)
 - a. 5th Nov 2016
 - b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/5094-ict-29-2016.html>

2017

- 165) Invited Talk and Panelist: Emerging Technologies Summit; Integrated Photonics session, Stanford University, as part of the Kingdom of the Netherlands trade mission to Silicon Valley
 - a. 10th Jan 2017
 - b. "Discussion with HRH Prince Constantijn and DG Bertolt Leefink about photonics ecosystem and startups. Photonics highlights (Michael Lebby)
 - c. Consulate General San Francisco, The Kingdom of Netherlands
 - d. <https://ez.atavist.com/emerging-technologies-summit>
- 166) Video: The importance of photonics roadmapping
 - a. 30th Jan 2017
 - b. Video on the importance of roadmapping photonics technologies at Photonics West San Francisco, 30th Jan 2017. Interview by Photon Delta.
 - c. <http://www.photondelta.eu>

- 167) Technical Advisor/Expert: 2nd review of MIRPHAB pilot line consortium funded by H2020 at European Commission
- 20th Feb 2017
 - 2nd review for MIRPHAB consortium at the European Commission, Brussels
 - European Commission, Brussels
 - <https://www.iaf.fraunhofer.de/en/research/research-areas/semiconductor-lasers/mirphab.html>
- 168) Technical Advisor/Expert: 2nd review of PI-SCALE project pilot line funded by H2020, European Commission
- 21st Feb 2017
 - 2nd review of PI-SCALE consortium pilot line at European Commission, Brussels
 - European Commission, Brussels, Belgium
 - <http://pi-scale.eu>
- 169) Technical Advisor/Expert: 1st review of PIXAPP pilot line consortium funded by H2020 at European Commission
- 21st Feb 2017
 - 1st Review of Pixapp project at EU Commission as part of the pilot line project.
 - European Commission, Brussels
 - <http://www.fabiodisconzi.com/open-h2020/projects/206352/index.html>
- 170) Invited Talk: Belgium LWLG Investor Group at the Royal Antwerp Golf Club
- 6th Mar 2017
 - Invited talk entitled "High performance polymer photonics for next generation PICs"
 - Belgium LWLG Investor Group
 - <http://www.lightwavelogic.com>
- 171) Chairman: PIC (Photonic Integrated Circuits) International Conference, Brussels, Belgium
- 7th Mar 2017
 - "Photonic Integrated Circuits International
 - CS International
 - <http://www.picinternational.net>
- 172) Invited Talk: Photonics Integration Circuits - Global Market Analysis 2017
- 13th Mar 2017
 - Invite by The Netherlands Department of Economics to review PIC technology and markets for potential investment.
 - The Dutch Government - Dept of Economics, The Hague together with Photon Delta, The Netherlands
 - <http://www.photondelta.eu>
- 173) Technical Advisor/Expert: 2nd review of PIX4LIFE pilot line consortium funded by H2020 at European Commission
- 14th Mar 2017

- b. 2nd review of PIX4LIFE pilot line consortium at the European Commission, Brussels.
 - c. European Commission, Brussels, Belgium
 - d. <http://www.pix4life.eu>
- 174) Keynote talk: Entitled "The rise of PIC based technologies over the next decade and how datacenters and telecom may enable other exciting applications"
 - a. 1st May 2017
 - b. Xilinx as part of their; "Xilinx silicon technology series seminars"
 - c. <http://www.xilinx.com>
- 175) Invited Talk: Lightwave Logic Inc Annual Shareholder Meeting "High Performance Polymer Photonics for Next Generation PICs"
 - a. 18th May 2017
 - b. Presentation of corporate technology and strategy for Lightwave Logic Inc and polymer PIC platforms.
 - c. Lightwave Logic Inc (OTCQB:LWLG)
 - d. <http://www.lightwavelogic.com/presentations>
- 176) Management/CEO presentation for Lightwave Logic Inc., at the Annual Shareholder Meeting (ASM).
 - a. 18th May 2017
 - b. Lightwave logic Inc., Boulder, Colorado.
 - c. Annual shareholder meeting for Lightwave Logic Inc., with live presentation with live Q&A from investors.
- 177) Plenary Talk: Global Market Research at the World Technology Mapping Forum, s'Hertogenbosch, Netherlands
 - a. 14th Jun 2017
 - b. "PhotonDelta and the AIM Photonics Academy are organising the first meeting of the World Technology Mapping Forum. The goal of the forum is to produce the first International Photonic Systems Roadmap, looking ahead to global technology needs in 2030 and beyond.
 - c. PhotonDelta, Netherlands as part of the International Photonics System Roadmap (IPSR) conference
 - d. <https://worldtechnologymappingforum.org/the-programme>
- 178) Video interview: World Photonic Mapping Forum; s'Hertogenbosch, Netherlands
 - a. 15th Jun 2017
 - b. Interview on photonics roadmaps.
 - c. PhotonDelta (via Videographer Jonathan Marks)
 - d. <https://worldtechnologymappingforum.org/the-programme>
- 179) Invited video 'Lightwave Logic roadmaps for polymer photonics at the 3rd International Roadmap conference, Eindhoven, Netherlands
 - a. 16th June 2017
 - b. PhotonDelta video PR team
 - c. <https://vimeo.com/317216466>
- 180) Invited talk and abstract: Polymer based PICs

- a. 14th Sep 2017
- b. ECOC, Datacenter technologies. Sweden
- 181) Video: Polymer based PICs
 - a. 15th Sep 2017 ECOC, Sweden as part of Market Focus at the ECOC Exhibit. (youtube: Michael Lebby ECOC 2017)
- 182) Keynote invited talk and abstract: PIC based technologies
 - a. 22nd Sep 2017
 - b. PIC Conference, The Netherlands
- 183) Invited talk and abstract: Polymer PIC technology as part of the Photonics Integrated Circuits (PIC) conference in Eindhoven, Netherlands.
 - a. 5th Oct 2017
 - b. PIC technologies and polymer photonics
- 184) Invited talk: PIC Training conference/workshop in Sunnyvale, Silicon Valley
 - a. PIC training session/workshop
- 185) Invited talk: Photonics Pilot Lines
 - a. 8th Dec 2017
 - b. European Commission, Photonics Proposers Meeting, Brussels

2018

- 186) International Roadmap meeting at Berenshot, Utrecht, Netherlands
 - a. 20th Jan 2018
 - b. Invited talk: International Roadmap meeting: Datacom/Telecom ICT markets, AOC, and Polymer PIC technology platforms
- 187) Co-Chairman: PIC (Photonic Integrated Circuits), International Conference, Brussels, Belgium
 - a. 10th Apr 2018
 - b. Photonic Integrated Circuits International
 - c. CS International
 - d. <http://www.picinternational.net>
- 188) Session chair and moderator: High volume, high performance PICs (Photonic Integrated Circuits) at the International Conference, Brussels, Belgium
 - a. 10th Apr 2018
 - b. Photonic Integrated Circuits International
 - c. CS International
 - d. <http://www.picinternational.net>
- 189) Session chair and moderator: Silicon Photonics (SiP) PICs (Photonic Integrated Circuits) at the International Conference, Brussels, Belgium
 - a. 11th Apr 2018

- b. Photonic Integrated Circuits International
 - c. CS International
 - d. <http://www.picinternational.net>
- 190) Invited Talk: Scalable PIC platforms: “The impact of using polymer PICs for 100 and 400Gbps datacom applications,” PICs (Photonic Integrated Circuits) at the International Conference, Brussels, Belgium
 - a. 10th Apr 2018
 - b. Photonic Integrated Circuits International
 - c. CS International
 - d. <http://www.picinternational.net>
- 191) Management/CEO presentation for Lightwave Logic Inc., at the Annual Shareholder Meeting (ASM).
 - a. 17th May 2018
 - b. Lightwave logic Inc., Denver, Colorado.
 - c. Annual shareholder meeting for Lightwave Logic Inc., with live presentation with live Q&A from investors.
- 192) Invited video ‘Welcome to WTMF 18’ at the 2nd International Roadmap conference, Eindhoven, Netherlands
 - a. 12th June 2018
 - b. PhotonDelta video PR team
 - c. <https://vimeo.com/275376937>
- 193) Reviewer: European Commission ICT-03-2018: Photonics Pilot lines (InP and silicon photonics PICs)
 - a. 11th Jun 2018
 - b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 194) Reviewer: European Commission ICT-04-2018: Tbps optical fiber optic transceivers
 - a. 11th Jun 2018
 - b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 195) Reviewer: European Commission ICT-04-2018: Connected lighting
 - a. 11th Jun 2018
 - b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 196) Workgroup chair and moderator: Telecom long haul roadmap committee at the International world mapping conference, Enschede, Netherlands
 - a. 20th Jun 2018
 - b. Photondelta Conference: chairing technical workgroup meetings to address photonics roadmap trends and challenges.

- c. Photondelta in coordination with iNEMI, and AIM photonics.
 - d. <https://www.photondelta.eu>
- 197) Invited talk: Telecom, Datacom, and ICT roadmap committee at the International world mapping conference, Enschede, Netherlands
 - a. 20th Jun 2018
 - b. Photondelta Conference: chairing technical workgroup meetings to address photonics roadmap trends and challenges.
 - c. Photondelta in coordination with iNEMI, and AIM photonics.
 - d. <https://www.photondelta.eu>
- 198) Invited talk and abstract: Pushing the performance of 50Gbps NRZ polymer modulators towards 100Gbps NRZ in a PIC platform to access 400 and 800Gbps data-rates
 - a. 25th Sep 2018
 - b. ECOC, Datacenter technologies. Sweden
- 199) Reviewer (European Commission) for pilot line PISCALÉ
 - a. 18th Sept 2018
 - b. European Commission, Brussels
 - c. PISCALÉ is a pilot line that is focused on bringing to commercial market flexible organic display technologies in both panel and reel to reel formats.
- 200) Reviewer (European Commission) for pilot line MIPHAB
 - a. 19th Sept 2018
 - b. European Commission, Brussels
 - c. MIPHAB is a pilot line that is focused on bringing to commercial market near infra-red devices and packaging for industrial, defense, military and high volume applications.
- 201) Video: Pushing the performance of 50Gbps NRZ polymer modulators towards 100Gbps NRZ in a PIC platform to access 400 and 800 Gbps datarates.
 - a. 25th Sept 2018
 - b. ECOC, Market Focus at the ECOC Exhibit, (Youtube: Michael Lebby ECOC 2018)
- 202) Invited talk and abstract: ECOC [International Symposium on Hybrid PICs](#) entitled "Polymer PICs: technology and prospects"
 - a. 26th Sept 2018
 - b. International Symposium on Hybrid PICs co-located at the ECOC conference, Rome, Italy.
- 203) Reviewer (European Commission) for pilot line PIXAPP
 - a. 2nd Oct 2018
 - b. European Commission, Brussels
 - c. PIXAPP is a pilot line that is focused on bringing to commercial market PIC (photonic integrated circuit) packaging solutions for InP and silicon photonics based technologies.
- 204) Reviewer (European Commission) for pilot line PIX4LIFE

- a. 3rd Oct 2018
- b. European Commission, Brussels
- c. PIX4LIFE is a pilot line that is focused on bringing to commercial market PIC dielectric solutions for applications in the visible wavelength range in the medical applications market.

2019

- 205) Invited talk: Polymer modulators and polymer PIC technologies: PIC Training conference/workshop in Sunnyvale, Silicon Valley
 - a. 28th Jan 2019
 - b. PIC training session/workshop at Keysight facility
- 206) Reviewer (European Commission) for pilot line MIPHAB
 - a. 16th Feb 2019
 - b. European Commission, Brussels
 - c. MIPHAB is a pilot line that is focused on bringing to commercial market near infra-red devices and packaging for industrial, defense, military and high volume applications.
- 207) Reviewer (European Commission) for pilot line PIX4LIFE
 - a. 25th Mar 2019
 - b. European Commission, Brussels
 - c. PIX4LIFE is a pilot line that is focused on bringing to commercial market PIC dielectric solutions for applications in the visible wavelength range in the medical applications market.
- 208) Co-Chairman: PIC (Photonic Integrated Circuits), International Conference, Brussels, Belgium
 - a. 26-27th Mar 2019
 - b. Photonic Integrated Circuits International
 - c. CS International
 - d. <http://www.picinternational.net>
- 209) Session chair and moderator: High volume, high performance PICs (Photonic Integrated Circuits) for Foundries at the International Conference, Brussels, Belgium
 - a. 26th Mar 2019
 - b. Photonic Integrated Circuits International
 - c. CS International
 - d. <http://www.picinternational.net>
- 210) Session chair and moderator: High volume PICs (Photonic Integrated Circuits) at the International Conference, Brussels, Belgium
 - a. 27th Mar 2019

- b. Photonic Integrated Circuits International
 - c. CS International
 - d. <http://www.picinternational.net>
- 211) Invited Talk: Polymer PICs for 400Gbps+ datacom applications,” PICs (Photonic Integrated Circuits) at the International Conference, Brussels, Belgium
 - a. 27th Mar 2019
 - b. Photonic Integrated Circuits International
 - c. CS International
 - d. <http://www.picinternational.net>
- 212) Reviewer (European Commission) for project CARDIS
 - a. 18th Apr 2019
 - b. European Commission, Brussels
 - c. CARDIS is an EU project for PIC based technology to monitor blood flow and artery stiffness in the human body using long wavelength lasers and silicon photonics.
- 213) Management/CEO presentation for Lightwave Logic Inc., at the Annual Shareholder Meeting (ASM).
 - a. 16th May 2019
 - b. Lightwave logic Inc., Denver, Colorado.
 - c. Annual shareholder meeting for Lightwave Logic Inc., with live presentation with live Q&A from investors with presentation:
<https://drive.google.com/file/d/1wh8irF8rmi9bU6VeGKAHFqVURyUcytdX/view?usp=sharing>
- 214) Reviewer: European Commission ICT-03-2019: Fiber optic communications and bio-photonics for medical applications
 - a. 6th June 2019
 - b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 215) Workgroup chair and moderator: Datacom roadmap committee at the International world mapping conference, Berlin, Germany
 - a. 12th June 2019
 - b. Photondelta Conference: chairing technical workgroup meetings to address photonics roadmap trends and challenges.
 - c. Photondelta in coordination with iNEMI, and AIM photonics.
 - d. <https://www.photondelta.eu>
- 216) Keynote speaker: ‘Global markets for PIC technologies’ at the 3rd International world mapping conference, at the Fraunhofer HHI, Berlin, Germany
 - a. 15th June 2019
 - b. Photondelta Conference: chairing technical workgroup meetings to address photonics roadmap trends and challenges.
 - c. Photondelta in coordination with iNEMI, and AIM photonics.
 - d. <https://www.photondelta.eu>

- 217) Reviewer: European Commission ICT-05-2019: Pilot lines (free form optics and integrated photonics for bio-medical applications)
 - a. 16th June 2019
 - b. European Commission: Reviewing submitted technical photonics proposals for Horizon 2020, and rate proposals to EU guidelines.
 - c. <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 218) Invited speaker: 'Lightwave Logic polymer modulator platform' at the Spring Investor Conference, NYC, NY
 - a. 2nd April 2019
 - b. Spring Investor Summit (Microcap Conference) (www.springinvestorsummit.com)
- 219) Invited video 'Lightwave Logic polymer modulator platform' at the Spring Investor Conference, NYC, NY
 - a. 2nd April 2019
 - b. Spring Investor Summit (Microcap Conference)
 - c. <https://www.youtube.com/watch?v=Mn4oICQpVTQ>
- 220) Invited video 'Lightwave Logic advancing its silicon photonic prototypes' by Proactive, (<https://www.proactiveinvestors.com>) NY
 - a. 2nd April 2019
 - b. Proactive video (Wall St) series:
<https://www.youtube.com/watch?v=3B0oGXvyogA>
 - c. Lightwave Logic, Inc. (OTCQX: LWLG) CEO Michael Lebby tells Proactive the Englewood, Colorado-based technology platform company is in discussions with large and small players within the telecommunications and data-communications space, including companies who are involved in the manufacturing routers.
- 221) Reviewer: (European Commission) for project InSiDe
 - a. 29th Apr 2019
 - b. European Commission, Brussels
 - c. InSiDe is an EU project for PIC based technology in the medical field to monitor blood flow and artery stiffness in the human body using long wavelength lasers and silicon photonics. Hospital clinical trials will be conducted. It is a follow-on with more clinical trials from the initial CARDIS EU project.
 - d. <http://www.inside-h2020.eu>
- 222) Invited video Interview by EPIC CTO Jose Pozo in EPIC's Photonics Industry Luminary video series.
 - a. 28th Jan 2019 (at Photonics West conference in San Francisco)
 - b. EPIC Trade Association, Europe
 - c. https://www.youtube.com/watch?v=e_V4TeTSwaM
- 223) Invited video 'Global Markets and Trends' at the 3rd International Roadmap conference, Faunhofer HHI, Berlin Germany
 - a. 16th June 2019
 - b. PhotonDelta video PR team
 - c. <https://vimeo.com/341952732>
- 224) Reviewer (European Commission) for pilot line PISCALE

- a. 11th Sept 2019
- b. European Commission, Brussels
- c. PISCALÉ is a pilot line that is focused on bringing to commercial market flexible organic display technologies in both panel and reel to reel formats.
- 225) Invited talk and abstract: ECOC International Symposium on Hybrid PICs entitled “Polymer modulators enable the next generation of speeds and low power in optical networks”
 - a. 22nd Sept 2019
 - b. International Symposium and workshop (WO5) on Hybrid PICs,
 - c. ECOC conference 2019, Dublin, Ireland
 - d. <https://www.ecoc2019.org/workshop.html>
- 226) Invited talk and abstract: “Polymer modulators with >50GHz performance for power consumption reduction at 400, 800, and 1600 Gbaud aggregated data-rates”
 - a. 24th Sept 2019
 - b. Market Focus Session, Photonics Integration and Digital Silicon Photonics,
 - c. ECOC 2019, Dublin, Ireland
 - d. <https://www.ecocexhibition.com/visit/market-focus/market-focus-2019-timetable/>
- 227) Video: Polymer modulators with >50GHz performance for power consumption reduction at 400, 800, and 1600 Gbaud aggregated datarates”
 - a. 24th Sept 2019
 - b. ECOC, Market Focus at the ECOC Exhibit, (Youtube: Michael Lebby ECOC 2019)
 - c. ECOC 2019, Dublin, Ireland
- 228) Chairman and moderator, Market Focus ECOC 2019 session: Service and Content Provider Optical Transmission
 - a. 24th Sept 2019
 - b. Market Focus Session #5, ECOC 2019, Dublin, Ireland
 - c. <https://www.ecocexhibition.com/visit/market-focus/market-focus-2019-timetable/>
- 229) Chairman and moderator, Market Focus ECOC 2019 session: Optical Network Agility/Software Defined Networks
 - a. 24th Sept 2019
 - b. Market Focus Session #7, ECOC 2019, Dublin, Ireland
 - c. <https://www.ecocexhibition.com/visit/market-focus/market-focus-2019-timetable/>
- 230) Reviewer (European Commission) for pilot line MIPHAB
 - a. 10th Dec 2019
 - b. European Commission, Brussels
 - c. MIPHAB is a pilot line that is focused on bringing to commercial market near infra-red devices and packaging for industrial, defense, military and high-volume applications.

2020

- 231) Webinar: Wall Street resource
 - a. 9th Jan 2020
 - b. Lightwave Logic HQ facilities in Denver, Colorado
 - c. A 30min recorded webinar answering questions on Lightwave Logic and its business plans, technology and plans for the future.
- 232) Invited video Interview by EPIC in EPIC's Photonics Industry video series on European funded pilot lines.
 - a. 5th Feb 2020 (at Photonics West conference in San Francisco)
 - b. EPIC Trade Association, Europe
- 233) Reviewer (European Commission) for pilot line InPULSE
 - a. 19th Mar 2020
 - b. European Commission, Brussels
 - c. InPULSE is a pilot line that is focused on bringing to commercial market InP based photonic integrated circuits (PICs) for fiber communications, both datacom as well as telecom high-volume applications.
- 234) Keynote and Plenary speaker SPIE Photonics Europe International Conference
 - a. Originally 31st March (then moved to 7th April 2020)
 - b. Strasbourg, France (the plenary talk was completed using audio embedded powerpoint video remotely).
 - c. The conference was held virtually in 2020 and the talk was attended by over 1000 attendees/visits.
 - d. <https://spie.org/profile/michael.lebby-4009?SSO=1>
- 235) Chairman (elected) of ECOC Market Focus technical committee as part of the ECOC Exhibition.
 - a. 10th May 2020
 - b. Committee hosted and organized by ECOC Exhibition
 - c. Market Focus Committee at: : <https://www.ecocexhibition.com/visit/market-focus/>
- 236) Invited speaker and presentation at Lightwave Logic Annual Shareholder meetings 2020 with Business Management Update, and presentation entitled, "Lightwave logic business review"
 - a. 14th May 2020
 - b. Presentation can be found at: https://drive.google.com/file/d/1xfisLKe6QIykCAIMjOZ0XdiR-Ht_O7zZ/view?usp=sharing
 - c. Hosted by Lightwave Logic Inc. and MZ Group (Investor Relations)
- 237) Co-Chair (and summit host) of online summit for PIC International virtual session with live Q&A.
 - a. 19th May 2020

- b. Hosted by Angel Tech (<https://onlinesummit.angel-tech.net/breakout/pic-international>)
 - c. Virtual conference with combination of pre-recorded presentations, live presentations, and live Q&A. Over 150 attendees.
- 238) Invited video clip on PIC technologies for online summit of PIC International conference.
 - a. 19th May 2020
 - b. Video clip (2:04) can be found at <https://onlinesummit.angel-tech.net/breakout/pic-international>
 - c. Summit host's introduction to the online summit PIC conference.
- 239) Invited speaker, EPIC 24hr Photonics World Tour virtual conference with talked entitled; "EO Polymers enable high speed and low power modulators at 1550nm and 1310nm."
 - a. 24th Jun 2020
 - b. EPIC 24hr Photonics World Tour final talk #72 and concluding remarks.
 - c. <https://www.epic-assoc.com/24hours/> and video on Youtube at: <https://www.youtube.com/watch?v=aiUSlfxPlz0> starting at 46:00
- 240) Invited paper/article entitled, "Electro-Optic Polymers Improve Speed and Power Efficiency" with co-authors Karen Liu and Cory Pecinovsky, Lightwave Logic Inc.
 - a. 5th Aug 2020
 - b. Published by Photonics Spectra magazine,
 - c. Hosted by photonics.com [https://www.photonics.com/Articles/Electro-Optic Polymers Improve Speed and Power/p5/vol180/i1193/a65902](https://www.photonics.com/Articles/Electro-Optic_Polymers_Improve_Speed_and_Power/p5/vol180/i1193/a65902)
- 241) Invited video interview, "2020 Market Focus and technology trends for ECOC 2020, Brussels, Belgium" as Chairman of ECOC 2020 Market Focus Technical Committee
 - a. 5th Aug 2020
 - b. Market Focus Exhibition for ECOC 2020,
 - c. Hosted by ECOC exhibition: <https://www.ecocexhibition.com/visit/market-focus/>
- 242) Chair and invited speaker, PIC International virtual conference on PICs: PIC Virtual II with presentation entitled; "Optical devices and industry roadmaps."
 - a. 2nd Nov 2020
 - b. PIC International Conference, (https://picmagazine.net/article/112351/AngelTech_Virtual_2_-_The_Sequel_Proves_A_Hit_Success) and (<https://onlinesummit.angel-tech.net>)
- 243) Invited speaker, EPIC Virtual Conference on Datacenters (in collaboration with EA and COBO) with presentation entitled; "Using polymer modulators to upgrade your PIC + Industry Roadmaps."
 - a. 4th Nov 2020
 - b. EPIC Trade Association and subsequent YouTube video (<https://www.youtube.com/watch?v=tHh-z724D2g>) and also at EPIC: <https://www.epic-assoc.com/epic-online-technology-meeting-on-datacenter-interconnects-in-cooperation-with-cobo-and-ea/>

- c. Hosted by EPIC
- d. Hosted by CS International and PIC International (Angel Business, London)
- 244) Reviewer (European Commission) for pilot line PIX4LIFE
 - a. 2nd Dec 2020
 - b. European Commission, Brussels (virtual review)
 - c. PIX4LIFE is a pilot line that is focused on bringing to commercial market PIC dielectric solutions for applications in the visible wavelength range in the medical applications market.

2021

- 245) Invited speaker, EPIC Photonics Plus conference (virtual) with a talk entitled “Polymer Plus™: Upgrading your PIC with Ultrafast and Low Power Modulators.”
 - a. 16th Feb 2021
 - b. EPIC Trade Association <https://photonicsplus.com> and also at EPIC: <https://photonicsplus.com/exhibitors/>
 - c. Hosted by EPIC
- 246) Invited speaker (updated virtual presentation), EPIC Photonics Plus conference (virtual) with a talk entitled “Commercializing Polymer Modulators.”
 - a. 10th Mar 2021
 - b. EPIC Trade Association <https://photonicsplus.com> and also at <https://www.lightwavelogic.com/presentation/video-presentation-commercializing-polymer-modulators/>
 - c. Hosted by EPIC
- 247) Invited Webinar and panelist: Roth Capital Partners (<https://www.roth.com/Page/Corporate-Access-Past-Conferences>)
 - a. 17th Mar 2021
 - b. 33rd Annual Roth Conference
 - c. Financial investment conference for public company review. Panelist for answering questions by bankers, investment specialists, and fund managers on Lightwave Logic and its business plans, technology and plans for the future.
- 248) Invited white paper/article entitled, “Polymers for Fiber Optic Communications: What does the Integrated Photonics Roadmap Say” co-authors Michael Lebby and Karen Liu, Lightwave Logic Inc.
 - a. 24th Mar 2021
 - b. Published by Lightwave Logic Inc., (https://www.lightwavelogic.com/wp-content/uploads/sites/319/2021/03/WP_IPSR-Roadmap-Decoded.pdf)
 - c. Executive summary: The IPSR (Integrated Photonic Systems Roadmap), a recent broad collaboration that unified the efforts of multiple established photonics

roadmap efforts, describes the key technology bottlenecks for a broad array of applications and most promising solutions to overcome them. This whitepaper highlights the portion of the roadmap specific to fiber optic communications and within that the implications for the role of electro-optic polymers. Key findings identify critical advances that will be needed over the next decade to support the growth of very high data rate applications. By the end of the decade, integration of electronics with photonics will be part of broad integrated platforms. Innovative materials technologies such as polymers can be useful to enhance integrated photonics platforms with the use of high- speed modulators and passive optical interconnects.

- 249) Reviewer (European Commission) for pilot line Phabulous
 - a. 31st Mar 2021
 - b. Via European Commission (virtual review)
 - c. Phabulous is a pilot line that is focused on bringing to commercial market micro-optics and free-form optics technology. Focus is on SMEs, prototyping and small volume manufacturing.
- 250) Chair and invited speaker, PIC International virtual conference on PICs: PIC Virtual III with presentation entitled; “Integrated photonic roadmaps.”
 - a. 12th Apr 2021
 - b. PIC International Conference,
(https://picmagazine.net/article/112351/AngelTech_Virtual_2_-_The_Sequel_Proves_A_Hit_Success) and (<https://onlinesummit.angel-tech.net>)
 - c. Hosted by CS International and PIC International (Angel Business, London)
- 251) Reviewer (European Commission) for pilot line InPULSE (also known as Jeppix)
 - a. 23rd Apr 2021
 - b. Via European Commission (virtual review)
 - c. InPULSE is a pilot line that is focused on bringing to commercial market InP based photonic integrated circuits (PICs) for fiber communications, both datacom as well as telecom high-volume applications.
- 252) Invited speaker, EPIC Virtual Conference on PIC Packaging with presentation entitled; “Integrated photonics roadmaps: enabling high performance packaging.”
 - a. 26th Apr 2021
 - b. EPIC Trade Association and subsequent YouTube video
(<https://www.youtube.com/watch?v=tHh-z724D2g>) and also at EPIC:
<https://www.epic-assoc.com/epic-online-technology-meeting-on-pic-packaging/>
 - c. Hosted by EPIC
- 253) Invited conference and panelist: Oppenheimer 6th Annual Virtual Emerging Growth Conference (<https://www.oppenheimer.com/events/2021/6th-annual-emerging-growth-conference.aspx>)
 - a. 11th May 2021
 - b. Oppenheimer 6th Annual Virtual Emerging Growth Conference.
 - c. Financial investment conference for public company review. Panelist for answering questions with a variety of bankers, investment specialists, and fund

- managers on Lightwave Logic and its business plans, technology and plans for the future.
- 254) Invited speaker and presentation at Lightwave Logic Annual Shareholder meetings 2021 with Business Management Update, and presentation entitled, “Lightwave logic business review”
 - a. 27th May 2021
 - b. Presentation can be found at: <https://www.lightwavelogic.com/presentation/2021-asm-business-update-por-lightwave-logic-ceo-dr-michael-lebby/>
 - c. Hosted by Lightwave Logic Inc. and MZ Group (Investor Relations)
 - 255) Keynote speaker for PITC opening ceremony with presentation entitled, “Photonic Integrated Circuits (PICs): Enabling our future...”
 - a. 2nd June 2021
 - b. Agenda at: <https://brainporteindhoven.com/en/events/launch-photonics-integration-techology-center> and presentation at: <https://www.lightwavelogic.com/presentation/photonic-integration-technology-center-keynote/>
 - c. Hosted by PITC (Photonics Integrated Technology Center); Photon Delta, TNO, Eindhoven University, Twente University.
 - 256) Invited speaker: LD Micro Invitational XI conference (virtual) with presentation entitled, “Lightwave Logic Investor Presentation”
 - a. 10th June 2021
 - b. Presentation at: <https://api.mziq.com/mzfilemanager/v2/d/307dbc8b-e212-48ba-9968-8cef3f6b5188/8c054319-48a6-bd6b-2a0c-66e56f5f489f?origin=2>
 - c. Hosted by LD Micro NASDAQ: SRAX
 - 257) Invited video interview: “2021 Market Focus and technology trends for ECOC 2021, Bordeaux, France” as Chairman of ECOC 2021 Market Focus Technical Committee
 - a. 15th June 2021
 - b. Market Focus Exhibition for ECOC 2021,
 - c. Hosted by ECOC exhibition: <https://www.ecocexhibition.com/visit/market-focus/>
 - 258) Invited speaker at HC Wainwright non-deal roadshow (virtual)
 - a. 3rd and 4th August 2021
 - b. Presentation of “Lightwave Logic investor presentation”
 - c. Hosted by HC Wainwright Investment Bank
 - 259) Invited speaker at Q3 Investor Summit (virtual)
 - a. 17th and 18th August 2021
 - b. Presentation of “Lightwave Logic investor presentation” and link: <https://drive.google.com/file/d/1mH0bCzOd8UxtvN6FeR50KIP7moFsFhjJ/view?usp=sharing>
 - c. Hosted by Investor Summit (<https://investorsummitgroup.com>)
 - 260) Invited speaker and video recording at HC Wainwright conference (virtual)
 - a. 13-15th September 2021
 - b. Presentation of “Lightwave Logic investor presentation”

- c. Hosted by HC Wainwright Investment Bank
- 261) Invited speaker and video interview at NASDAQ for 10th September 2021 marketing closing. Live interview at NASDAQ HQ in Times Square, NYC.
 - a. 10th September 2021
 - b. Live interview for TV networks of Lightwave Logic's aspirations.
 - c. Hosted by NASDAQ at their TV studios: <https://www.nasdaq.com/videos/lightwave-logic-inc.-rings-the-nasdaq-stock-market-opening-bell>
- 262) Invited interview to close the week of trading at NASDAQ on 10th September, 2021 with live speech, and televised session. The closing was carried by CNBC, FOX, Bloomberg, BNN networks during the close session.
 - a. 10th September, 2021
 - b. Live interview for Lightwave Logic, and live market closing for NASDAQ
 - c. Hosted by NASDAQ at their TV studios: <https://youtu.be/8dmHC8MeF6E>
- 263) TV and video interview by TD Ameritrade in conjunction with the ringing of the closing bell at NASDAQ on 10th September, 2021
 - a. 10th September 2021
 - b. Live TV interview on TD Ameritrade at NASDAQ studios, Time Square, NYC
 - c. Hosted by TD Ameritrade financial network; <https://tdameritradenetwork.com/video/rB4A-HvPH-2Be9Hw1tYC0w>
- 264) Session chairman: ECOC Market Focus technical committee as part of the ECOC Exhibition: sessions included PIC and Silicon Photonics, Optics in Cloud computing, optical transmission (SDN, network agility), Fiber Access, 5G, Cable, PON, FTTX, FTTC, Fiber to the room, New technologies and optical systems, New markets, and new packaging platforms.
 - a. 13th September 2021
 - b. Committee hosted and organized by ECOC Exhibition
 - c. Market Focus Committee at : <https://www.ecocexhibition.com/visit/market-focus/>
- 265) Invited video interview: "2021 Market Focus impact for ECOC 2021, Bordeaux, France" as Chairman of ECOC 2021 Market Focus Technical Committee at the conference by ECOC TV <https://www.youtube.com/watch?v=VrFeSwqnWak>
 - a. 13th September 2021
 - b. Market Focus Exhibition for ECOC 2021,
 - c. Hosted by ECOC exhibition: <https://www.ecocexhibition.com/visit/market-focus-with-video-at>
- 266) Invited talk and abstract: "Advancing integrated photonics with elector-optic polymer modulators".
 - a. 13th September 2021

- b. Market Focus Session, PIC and SiPH/Datacenters/Optics in cloud computing, <https://www.ecocexhibition.com/visit/market-focus/market-focus-2021-session-details/>
 - c. ECOC 2021, Bordeaux, France
- 267) Winner: Acceptance of glass trophy for ECOC Industry awards on behalf of Lightwave Logic in the optical integration category: <https://www.ecocexhibition.com/visit/ecoc-exhibition-industry-awards/>
 - a. 14th September 2021
 - b. Product Focus session, ECOC Exhibition Industry Award Winner Announcement
 - c. ECOC 2021, Bordeaux, France
- 268) Interview: ECOC Industry awards on behalf of Lightwave Logic in the optical integration category by ECOC TV
 - a. 14th September 2021
 - b. Product Focus session, ECOC Exhibition Industry Award Winner Announcement
 - c. ECOC 2021, Bordeaux, France
- 269) Video interview: PIC International Conference November 9-11, Brussels, Belgium
 - a. 24th September 2021
 - b. Overview of conference, technical sessions, and integrated photonics
 - c. PIC International, Brussels, Belgium as part of the online web portal presence.
- 270) Reviewer (European Commission) for pilot line InPULSE (also known as Jeppix)
 - a. 21st Sep 2021
 - b. Via European Commission (virtual review)
 - c. MedPhab is a pilot line that is focused on bringing to commercial market silicon photonics based technologies for medical applications. Demonstrator use-cases as prototype products have been selected for the validation of the pilot line technologies covering both *in-vivo* and *in-vitro* domains. The cases include: manufacturing a disposable plasmonic-fluidic sensors and a wearable PCI temperature sensor.
 - d. <https://medphab.eu>
- 271) Reviewer: (European Commission) for pilot line MIRPHAB
 - a. 28th Sep 2021
 - b. Via European Commission (virtual review)
 - c. MIRPHAB is a pilot line that is focused on bringing to commercial market infra-red wavelength modules and technologies based on quantum cascade lasers, MIR detectors, Antimonide based compound semiconductors and their associated packaging.
 - d. <https://www.iaf.fraunhofer.de/en/research/research-areas/semiconductor-lasers/mirphab.html>
- 272) Reviewer: (European Commission) for pilot line InPULSE (also known as Jeppix)
 - a. 1st Oct 2021
 - b. Via European Commission (virtual review)

- c. InPULSE is a pilot line that is focused on bringing to commercial market InP based photonic integrated circuits (PICs) for fiber communications, both datacom as well as telecom high-volume applications.
 - d. <https://www.inpulse.jepix.eu>
- 273) Invited Video presentation: LD Micro Main Investor conference entitled “Investor Presentation for LD Micro”
 - a. 12th October 2021
 - b. For virtual attendees at the LD Micro conference in Los Angeles (Luxe Hotel), California
 - c. Invited video presentation for virtual audience at LD Micro main event in LA California: https://www.meetmax.com/sched/event_76871/conference_home.html
 - d. <https://www.youtube.com/watch?v=JEvSV8qYGMA>
- 274) Invited audio interview: LD Micro for BIZPOD (the Drill Down by Cory Johnson).
 - a. 12th October 2021
 - b. Located at LD Micro main in LA, California
 - c. BIZPOD audio interview as part of their start-up entrepreneur series: <https://www.bizpod.net>
- 275) Invited oral presentation: Includes Q&A for LD Micro Main Investor conference entitled “Investor Presentation for LD Micro”
 - a. 12th October 2021
 - b. For live in-person attendees at the LD Micro conference in Los Angeles (Luxe Hotel), California
 - c. Invited live presentation on Lightwave Logic technology and business plans for virtual audience at LD Micro main event in LA California: https://www.meetmax.com/sched/event_76871/conference_home.html
 - d. <https://www.youtube.com/watch?v=JEvSV8qYGMA> and https://me21.mysequire.com/recording?session_id=d354f581-6ab6-47d9-99de-d642c1c25d87
- 276) Invited Video presentation: Ladenburg Thalmann Virtual Technology Expo conference entitled “Investor Presentation for Ladenburg Thalmann virtual Technology Expo Investor Presentation”
 - a. Video-taped on 27th October 2021 for release on 18th November 2021
 - b. For virtual attendees at the Thalmann Virtual Technology Expo conference.
 - c. Invited video presentation for virtual audience at 2021 Ladenburg Thalmann Virtual Technology Expo: <https://ladenburg21.mysequire.com>
 - d. Presentation can be found at: <https://ladenburg21.mysequire.com>
- 277) Invited video: Chairmans introduction to the 5th PIC International Conference, www.picinternational.net,
 - a. 7th-10th November 2021
 - b. Conference hosted by Angel events.
 - c. Sheraton Airport Hotel, Brussels, Belgium.
- 278) Session Chairman: 2nd PIC Pilot Line Conference, , www.picinternational.net,

- a. 7th November 2021
 - b. Conference hosted by Angel events.
 - c. Sheraton Airport Hotel, Brussels, Belgium.
- 279) Keynote speaker: Includes presentation entitled, “PIC Pilot Lines: Competitive Positioning” as part of the of 2nd PIC Pilot Line Conference, , www.picinternational.net,
- a. 7th November 2021
 - b. As of the conference hosted by Angel events.
 - c. Sheraton Airport Hotel, Brussels, Belgium.
- 280) Session chairman: 5th PIC International conference, www.picinternational.net
- a. 8-10th November 2021
 - b. Conference hosted by Angel events together with CS International, SSI International, and PIC Pilot Line Conference.
 - c. Sheraton Airport Hotel, Brussels, Belgium.
- 281) Invited Panelist: For the panel entitled, “PICs for LIDAR” of 6th PIC International conference, www.picinternational.net
- a. 8-10th November 2021
 - b. Conference hosted by Angel events together with CS International, SSI International, and PIC Pilot Line Conference.
 - c. Sheraton Airport Hotel, Brussels, Belgium.
- 282) Invited speaker: With presentation entitled, “Increasing power efficiency with electro-optic (EO) polymers” at the 5th PIC International conference, www.picinternational.net in the day 2 session, “PICs vision- evolution and revolution”
- a. 8-10th November 2021
 - b. Conference hosted by Angel events together with CS International, SSI International, and PIC Pilot Line Conference.
 - c. Sheraton Airport Hotel, Brussels, Belgium.
- 283) Keynote speaker: For Macrotrends (<http://arnaarteconomics.com/dagvandetips2020/>) investor conference (<https://vimeo.com/653240070>) and talk entitled “Investor Presentation”
- a. 12th November 2021
 - b. Conference hosted by Marcotrends with 200 in person attendees, and 3-500 online attendees.
 - c. Ghent, Belgium
- 284) Invited Live TV interview: Benzinga (Spencer Israel show).
- a. TV interview on 7th Dec 2021 with youtube recording: <https://www.youtube.com/watch?v=kS-7FVTNE2Y>
 - b. Presentation can be found at: <https://www.youtube.com/watch?v=kS-7FVTNE2Y> and the Spencer Israel show/background at <https://www.linkedin.com/in/spencer-israel-44b02b31/> and <https://www.benzinga.com/author/spencer-israel>

2022

- 285) Invited Live TV interview: Benzinga (Spencer Israel show).
- TV interview on 11th Feb 2022 with youtube recording: <https://www.youtube.com/watch?v=jFiB9P3voUk>
 - Presentation can be found at: <https://www.youtube.com/watch?v=jFiB9P3voUk> and the Spencer Israel show/background at <https://www.linkedin.com/in/spencer-israel-44b02b31/> and <https://www.benzinga.com/author/spencer-israel>
- 286) Invited Webinar and panelist: Roth Capital Partners at the 34th Annual Roth Dana Point Conference, (<https://www.roth.com/Page/Corporate-Access-Past-Conferences>) with Lightwave Logic investor presentation and meetings.
- 13-15th March 2022
 - 34th Annual Roth Deer Valley Conference (invite only)
 - Financial investment conference for public company review. Panelist for answering questions by bankers, investment specialists, and fund managers on Lightwave Logic and its business plans, technology and plans for the future.
- 287) Invited Article and Interview entitled: “Q&A: Electro-optic polymers herald a new age of ultra-fast communication.” With Digital Journal (<https://www.digitaljournal.com>), and interviewer; Dr. Tim Sandle.
- Digital Journal interview and publication on 1st April 2022 in the Digital Journal.
 - Article and interview can be found at: <https://www.digitaljournal.com/tech-science/qa-electro-optic-polymers-herald-a-new-age-of-ultra-fast-communication/article>
- 288) Invited Article entitled: “Electro-optic polymers allow faster, more efficient data transmission.” With Broadband Communities (<https://www.bbcmag.com>)
- Published in Broadband Communities 13th April 2022.
 - Article can be found at: https://www.bbcmag.com/pub/doc/BBC_Mar22_webFINAL.pdf
- 289) Invited video: Chairmans introduction to the 6th PIC International Conference, www.picinternational.net, recorded on 10th May 2022.
- 8th May 2022 to be published in May 2022 for the conference being held on 27-29th June 2022
 - Conference hosted by Angel events.
 - Sheraton Airport Hotel, Brussels, Belgium.
- 290) Invited speaker at Oppenheimer 7th Annual Emerging Growth Conference (virtual)
- 10th May 2022
 - Presentation of “Lightwave Logic investor presentation”
 - Hosted by Oppenheimer Investment Bank: https://www.meetmax.com/sched/event_80933/conference_invlogin.html?event_id=80933&username=LWLG&confirmation_number=MVRJ8BYW865 and <https://www.oppenheimer.com/events/2022/7th-annual-emerging-growth-conference.aspx>

- 291) Invited interview: Authority Magazine: “The future of communication technology”
- 11th May 2022, and published 18th May 2022.
 - Interview on the future of communications, hosted by <https://medium.com/authority-magazine>
 - Interview with David Liu, Authority Magazine
- 292) Reviewer (European Commission) for pilot line InPULSE (also known as Jeppix)
- 17th May 2022
 - Via European Commission (virtual review)
 - InPULSE is a pilot line that is focused on bringing to commercial market InP based photonic integrated circuits (PICs) for fiber communications, both datacom as well as telecom high-volume applications.
- 293) Invited speaker and presentation at Lightwave Logic Annual Shareholder meetings 2022 with Business Management Update, and presentation entitled, “Lightwave logic CEO management review”
- 26th May 2022
 - Presentation can be found at: <https://www.lightwavelogic.com/presentation/2021-asm-business-update-por-lightwave-logic-ceo-dr-michael-lebby/> and stream-video at: https://viaavid.webcasts.com/starthere.jsp?ei=1544482&tp_key=3c8d96d340
 - Hosted by Lightwave Logic Inc. and MZ Group (Investor Relations)
- 294) Invited oral presentation: LD Micro 12th Annual LD Micro Invitational conference with presentation entitled, “Lightwave Logic”
- 7th June 2022
 - Presentation Webcast can be found at: <https://me21.mysequire.com/>
 - Hosted by LD Micro NASDAQ: SRAX and located at Four Seasons in Westlake Village, California on 7-8th June 2022.
- 295) Invited video presentation: LD Micro XII Annual Invitational conference, recorded on 25th May 2022 (<https://ldinv12.sequireevents.com>)
- 7th June 2022
 - Presentation at : <https://me21.mysequire.com/>
 - Hosted by LD Micro NASDAQ: SRAX at the Four Seasons in Westlake Village, California on 7-8th June 2022.
- 296) Invited speaker and presentation at MIT IPSRI roadmap event with presentation entitled “Transceiver roadmap 2022”.
- 10th June 2022
 - Presentation can be found at: <https://photonicsmanufacturing.org/how-get-involved>
 - and <https://www.eventbrite.com/e/2022-spring-ipsr-i-roadmap-meeting-tickets-323380047427>
 - Hosted by IPRSI, MIT, and PhotonDelta world photonics roadmap

- 297) Board member Optica's Corporate Engagement Council, with activities focusing on industrial membership, marketing, conferences, workshops, meetings etc., for the photonics community globally.
- 10th June 2022, election to the CEC (https://www.optica.org/en-us/about/leadership_and_volunteers/councils/councils/)
 - CEC listing: https://www.optica.org/en-us/about/leadership_and_volunteers/councils/councils/#Industry
 - Optica (Optical Society of America – previous name)
- 298) Reviewer: European Commission HORIZON-CL4-2022-DIGITAL-EMERGING-01-38 (CSA): International cooperation in semiconductors
- 8th June 2022
 - European Commission: Reviewing submitted technical and coordinated support actions for electronics and photonics proposals for Horizon 2022 evaluation calls and rate proposals to EU guidelines.
 - CSA: <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 299) Reviewer: European Commission HORIZON-CL4-2022-DIGITAL-EMERGING-01-03: Advanced multi-sensing systems.
- 10th June 2022
 - European Commission: Reviewing submitted technical photonics proposals for Horizon 2022 evaluation calls and rate proposals to EU guidelines.
 - RIA: <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020>
- 300) Invited live interview with Dan Loney, Wharton Business Daily Radio Station
- 15th June 2022
 - Wharton Business Daily live radio interview. Subject: Lightwave Logic business and technology plans for growth: <https://twitter.com/whartonbizdaily?lang=en>
 - Location: virtual recording at Lightwave Logic, Englewood, CO.
- 301) Invited speaker at Diamond Equity Research Emerging Growth Invitational Conference (virtual)
- 17th June 2022
 - Presentation of “Lightwave Logic investor presentation”
 - Hosted by Diamond Equity Research Bank: <https://www.diamondequityresearch.com/conferences/> at Lightwave Logic, Englewood, Colorado.
- 302) Invited video interview: “2022 Market Focus impact for ECOC 2022, Basel, Switzerland” as Chairman of ECOC 2022 Market Focus Technical Committee at the conference by ECOC TV (link to be published)
- 17th June 2022
 - Market Focus Exhibition, technical sessions and awards for ECOC 2022,
 - Hosted by ECOC exhibition: <https://www.ecocexhibition.com/ecoc-exhibition-2022/> and recorded virtually in San Francisco, CA.

- 303) Invited interview: MicrocapDaily: “Microcapdaily Interviews Dr. Michael Lebby CEO of Lightwave Logic, Inc. (NASDAQ: LWLG) On Radical Innovation Needed to Keep the Internet Growing”
- 23rd June 2022
 - Interview on the radical innovation needed for the internet and optical networking, hosted by <https://microcapdaily.com/microcapdaily-interviews-dr-michael-lebby-ceo-of-lightwave-logic-inc-nasdaq-lwlg-on-radical-innovation-needed-to-keep-the-internet-growing-2/>
 - Interview with Boe Rimes, Microcap Daily
- 304) Session chairman: 7th PIC International conference, www.picinternational.net
- 28-29th June 2022
 - Conference hosted by Angel events together with CS International and SSI International.
 - Sheraton Airport Hotel, Brussels, Belgium.
- 305) Invited Panelist: For the panel entitled, “Optica Industry Panel: Hybrid Integration” of 6th PIC International conference, www.picinternational.net
- 28-29th June 2022
 - Conference hosted by Angel events together with CS International, and SSI International.
 - Sheraton Airport Hotel, Brussels, Belgium.
- 306) Invited speaker: With presentation entitled, “Enabling low power consumption optical networking using high speed, low power polymer modulators” at the 6th PIC International conference, www.picinternational.net in the day 2 session, “Optimizing the PIC architecture”
- 28-29th June 2022
 - Conference hosted by Angel events together with CS International, and SSI International.
 - Sheraton Airport Hotel, Brussels, Belgium.
- 307) Invited speaker: “Status of Lightwave Logic and electro-optic polymers” at the Cleydael Golf Club, Antwerp, Belgium (www.cleydael.be)
- 30th June 2022
 - Meeting organized by Belgium and Dutch retail investors of Lightwave Logic Inc. (NASDAQ:LWLG)
 - Location: Belgium
- 308) Invited Article for 7th PIC conference entitled, “PIC International proved to be a fantastic success” (<https://angel-tech.net/marketing/2022/mailers/post-show/pic/>)
- 7th July 2022
 - Conference hosted by Angel events together with CS International, and SSI International.
 - Sheraton Airport Hotel, Brussels, Belgium.
- 309) Invited Live TV interview: Benzinga All Access Fireside Chat (Zunaid Suleman show).

- a. TV interview on 22nd July 2022 with youtube recording:
https://www.youtube.com/watch?v=TyKY9R8WT_U
- b. Video interview can be found at: <https://www.benzinga.com/markets/emerging-markets/22/07/28231018/lightwave-logic-the-company-with-a-proprietary-solution-to-make-transmitting-data-faster> and the Zunaïd Suleman show/background at <https://www.benzinga.com/events/speakers/zunaïd-suleman/>
- c. Location: Virtually recorded in Washington DC
- 310) Invited Live TV interview with SNN network show Planet MicroCap Podcast and host Robert Kraft: <https://www.youtube.com/watch?v=zCD-hTKtkLg>
 - a. 22nd July 2022
 - b. Hosted by SNN and Robert Kraft, and video interview can be found at: <https://podcasts.apple.com/us/podcast/lightwave-logic-nasdaq-lwlg-designing-modulators-that/id1024217659?i=1000574742796>
 - c. Location: Virtually recorded in Washington DC
- 311) Invited Live Radio interview with Bloomberg markets radio show and hosts Paul Sweeney and Matt Miller. Topic, “Lightwave Logic background, radical innovation, business plans, impact on the internet, and where will the industry go in 5years?” Link to radio interview: “[Efficient Data Transmission \(Audio\).](#)”
 - a. 9th August 2022
 - b. Hosted by Paul Sweeney and Matt Miller at Bloomberg Market Radio show <https://www.bloombergradio.com/shows/bloomberg-markets-am/>
 - c. Location: recorded at Lightwave Logic, Englewood, Colorado.
- 312) Invited video interview with Smart Photonics’ “50 Leaders of change” to address where the internet is going from a technology, photonics, and optical networking system perspective. Filmed by London based TBD Media and can be found at: <https://vimeo.com/tbdmediagroup/review/742996199/8dc9821c7a>. with interview at 3:00-50.
 - a. 10th August 2022
 - b. Hosted and videoed by TBD Media hub on [Bloomberg.com](https://www.bloomberg.com)
 - c. Location: Filmed at Lightwave Logic HQ in Englewood, Colorado and released on 9th November 2022.
- 313) Invited talk: Jefferies Semiconductors, IT Hardware & Communications Infrastructure Summit
 - a. 29-31st August 2022
 - b. Hosted by Jefferies Investment Banking
 - c. Sofitel Hotel, Chicago, Illinois
- 314) Invited lecture – TU/e (University of Eindhoven, Netherlands); Electrical Engineering (Photonics); “Polymer Modulators”
 - a. 2nd September 2022
 - b. Hosted by Photonics Integrated Circuits team, Electrical Engineering, TU/e
 - c. TU/e (Eindhoven University), Eindhoven, Netherlands
- 315) Invited review PhD thesis and defense that included review of thesis, public questions for the candidate and ceremonial procession. Amir Abbas Kashi’s thesis is

entitled, “Electro-optic slot waveguide phase modulators on the InP membrane on silicon platform”

- a. 2nd September 2022
 - b. Hosted by TU/e Electrical Engineering, integrated photonics department with co-reviewers including: Prof. J. Leuthold, Prof. K. Williams, and Prof. Van der Tol.
 - c. TU/e (Eindhoven University), Eindhoven, Netherlands
- 316) Invited keynote talk as part of the ‘New Materials in PICs’ at “EPIC meeting on CMOS compatible integrated photonics at IMEC.” With link to website: <https://epic-assoc.com/events/epic-meeting-on-cmos-compatible-integrated-photonics-at-imec/>
- a. 7-8th September 2022 with the talk on the 8th September 2022
 - b. Hosted by IMEC and EPIC photonics association. With EPIC photonics at: <https://epic-assoc.com>
 - c. Location at Leuven, Belgium at IMEC 1 foundry.
- 317) Invited speaker: “Status of Lightwave Logic and electro-optic polymers for foundry applications” at the Cleydael Golf Club, Antwerp, Belgium (www.cleydael.be)
- a. 8th September 2022
 - b. Meeting organized by Belgium and Dutch retail investors of Lightwave Logic Inc. (NASDAQ:LWLG)
 - c. Location: Belgium
- 318) Invited talk at HW Wainwright conference called: ‘H.C. Wainwright 24th Annual Global Investment Conference’, with a talk entitled, “Lightwave Logic Investor Presentation” and link to website: <https://journey.ct.events/hub/660eb381-b261-4d25-afae-35b654ed04c1> and <https://hcwco.com>
- a. 12 and 13th September 2022 (talk on 13th September 2022)
 - b. Meeting organized by HC Wainwright Investment Banking (<https://hcwco.com>)
 - c. Location: Lotte Palace Hotel, New York City, NY
- 319) Invited interview: Interviewed by Greg Bryan at Telegeography (<https://www2.telegeography.com>) Podcast which can be found at: <https://telegeography.podbean.com/> as well as <https://blog.telegeography.com/simply-illuminating-considering-the-future-of-optical-transport>
- a. 16th September 2022
 - b. Published by Telegeography Podcast and Greg Bryan on 27th September 2022
 - c. Virtual interview
- 320) Invited review article: Subject was for EPIC on their CMOS-foundry workshop : <https://epic-assoc.com/events/epic-meeting-on-cmos-compatible-integrated-photonics-at-imec/>
- a. 13th September 2022
 - b. Published by EPIC photonics association and associated media outlets
 - c. Review written in NYC, 13th September 2022
- 321) Invited article: Ping! Zine technology insights and can be found at: <https://www.pingzine.com/featured-article/the-radical-innovation-of-a-new-polymer-internet/>
- a. 29th September 2022

- b. Published by Ping! Zine technology insights on 29th September 2022
 - c. Ping! Zine publishes in-depth content through authoritative contribution and thorough interviews with technology subject matter experts across multiple disciplines including cloud, data center, AI, big data, cybersecurity and more.
- 322) Session chairman: ECOC Market Focus technical committee as part of the ECOC Exhibition: sessions included PIC and Silicon Photonics, Optics in Cloud computing, optical transmission (SDN, network agility), Fiber Access, 5G, Cable, PON, FTTX, FTTC, Fiber to the room, new technologies and optical systems, new markets, and new packaging platforms.
 - a. 19-21st September 2022
 - b. Committee hosted and organized by ECOC Exhibition
 - c. Market Focus Committee at : <https://www.ecocexhibition.com/visit/market-focus/>
- 323) Invited video interview: “2022 Market Focus impact for ECOC 2022, Basel, Switzerland,” as Chairman of ECOC 2022 Market Focus Technical Committee at the conference by ECOC TV <https://youtu.be/X8iQoB4vqaA>
 - a. 20th September 2022
 - b. Market Focus Exhibition for ECOC 2022,
 - c. Hosted by ECOC exhibition: <https://www.ecocexhibition.com/visit/market-focus/>
- 324) Invited talk and abstract: “Utilizing foundries to scale hybrid electro-optic polymer modulators” with Dr. John Zyskind, VP Engineering, Lightwave Logic Inc: <https://www.ecocexhibition.com/visit/market-focus/components-ics-pics-fiber/>
 - a. 19th September 2022
 - b. Market Focus Session, PIC components
<https://www.ecocexhibition.com/visit/market-focus/market-focus-timetable-2022/>
 - c. ECOC 2022, Basel, Switzerland
- 325) Interview, industry award chairman, and award presentation to Market Focus Industry Award winners: ECOC exhibition industry awards (in conjunction with optical connections magazine) <https://www.ecocexhibition.com/visit/ecoc-exhibition-industry-awards/> :
 - a. 20th September 2022
 - b. Product Focus session, ECOC Exhibition Industry Award Winner Announcement
 - c. ECOC 2022, Basel, Switzerland
- 326) Market Focus Interview: ECOC TV on behalf of Lightwave Logic in the optical integration category by ECOC TV and can be found at: <https://youtu.be/nRd3dYCozUM>
 - a. 21st September 2022
 - b. Market Focus Session, PIC components
<https://www.ecocexhibition.com/visit/market-focus/market-focus-timetable-2022/>
 - c. ECOC 2022, Basel, Switzerland

- 327) Invited talk and panelist for ECOC Rump session, with talk entitled, “Hybrid Integration Roadmap: From pilot production to production in a semiconductor fab” at ECOC technical conference, chaired by Dr Jose Pozo, CTO Optica.
- 21st September 2022
 - ECOC Rump session
 - ECOC 2022, Basel, Switzerland
- 328) Paper (co-author): Post-deadline submission to ECOC 2022 entitled, “[Thermally Stable Silicon-Organic Hybrid \(SOH\) Mach-Zehnder Modulator for 140 GBd PAM4 Transmission With Sub-1 v Drive Signals \(Th3B.2\)](#)” given by Carsten Eschenbaum, *Karlsruhe Inst Tech (KIT)* and SilOriX GmbH.
- 22nd September 2022
 - ECOC Post Deadline session 1; 13:42 to 13:54pm
https://www.optica.org/events/topical_meetings/ecoc/schedule/?day=Thursday#Th3B.2
 - ECOC 2022, Basel, Switzerland
- 329) Cited Acknowledgement for Post Deadline Paper: Post-deadline submission to ECOC 2022 entitled, “[>500 GHz Bandwidth Graphene Photodetector Enabling Highest-Capacity Plasmonic-to-Plasmonic Links \(Th3B.5\)](#)” given by Stefan Koepfli, *Eidgenössische Technische Hochschule (ETH) Zurich*.
- 22nd September 2022
 - ECOC Post Deadline session 1; 14:18 to 14:30pm
https://www.optica.org/events/topical_meetings/ecoc/schedule/?day=Thursday#Th3B.5
 - ECOC 2022, Basel, Switzerland
- 330) Invited presentation: Diamond Equity Research’s annual Spotlight Emerging Growth Invitational Virtual Investor Conference, with a presentation entitled, “Lightwave Logic Investor Presentation” and can be found at https://us02web.zoom.us/webinar/register/WN_2aoRT-XPSZiCFd1cLkVrXA and <https://finance.yahoo.com/news/diamond-equity-research-host-spotlight-113000297.html>
- 4th October 2022 (10:20-10:50am East coast time)
 - Diamond Equity Research’s Spotlight Emerging Growth Invitational Virtual Investor Conference, conferences@diamondequityresearch.com
 - Recorded 30th September 2022 virtually at LWLG.
- 331) Invited interview: Interviewed by Cory Johnson at The Drill Down podcast (<https://twitter.com/drilldownpod?lang=en>) Podcast which can be found at: <https://www.iheart.com/podcast/269-the-drill-down-81530167/> as well as <https://twitter.com/DrillDownPod/status/1449964020522360836>
- 7th October 2022
 - Published by The Drill Down Podcast and Cory Johnson on 17th October 2022
 - Virtual interview
- 332) Invited oral presentation: LD Micro Main Event XV conference with presentation entitled, “Lightwave Logic Update”
- 25th October 2022

- b. Oral presentation details can be found at:
https://www.meetmax.com/sched/event_86249/conference_home.html as well as
https://www.meetmax.com/sched/event_86249/conference_presentations.html?bank_access=0&event_id=86249
 - c. Hosted by LD Micro NASDAQ: SRAX
- 333) Invited video presentation: LD Micro Main Event XV conference, recorded on 25th October 2022
 - a. 25th October 2022
 - b. Presentation at:
https://www.meetmax.com/sched/event_86249/conference_presentations.html?bank_access=0&event_id=86249
 - c. Hosted by LD Micro NASDAQ: SRAX at the Luxe Sunset Boulevard Hotel LA 24-26th October 2022
- 334) Invited closing comments: Optica Co-packaged and pluggable optics industry summit. Comments were on pluggables vs co-packaged integrated photonics solutions, roadmapping, and transceiver trends on data rate and low power consumption.
 - a. 25th and 26th October 2022
 - b. Details on the event can be found at: https://www.optica.org/en-us/events/industry_events/2022_optica_industry_summit/
 - c. Hosted by Optica (formally OSA) <https://www.optica.org/en-us/home/> at Du Pont's innovation laboratories Sunnyvale, CA.
- 335) Invited speaker: Photonics Spectra Annual Conference with presentation entitled, "How electro-optic polymers boost PIC speed and power efficiency".
 - a. Recorded on 28th October 2022, for 9-11th January 2023
 - b. Details on the event can be found at:
<https://www.photonics.com/Advertise/MarketingBlog.aspx?AID=68312>
 - c. Hosted by Photonics Spectra (www.photonics.com)
- 336) Invited talk at the Board meeting of Optica's Corporate Engagement Council. Presentation on focusing to increase industrial membership, improve marketing, optimize conferences and workshops for the industrial photonics community globally. (https://www.optica.org/en-us/about/leadership_and_volunteers/councils/councils/)
 - a. 1st November 2022,
 - b. CEC listing: https://www.optica.org/en-us/about/leadership_and_volunteers/councils/councils/#Industry
 - c. Optica (Optical Society of America – previous name)
- 337) Invited interview with Laser Focus editor Peter Fretty, Editor in Chief of [LASER FOCUS WORLD](http://www.laserfocusworld.com), on the subject of Lightwave Logic, and the radical innovation needed by the optical network and internet.
 - a. 3rd November 2022,
 - b. Laser Focus world can be found at: <https://www.laserfocusworld.com> and the magazine at: <https://www.laserfocusworld.com/magazine>
 - c. Laser Focus World

- 338) Invited panel moderator at PIC Summit Conference, Eindhoven, Netherlands in conjunction with IPSR-I workshops. Panel entitled, “Heterogeneous Intergration: Electronics and Photonics united” with companies that included: IMEC, LionX, VTT, Ligentec, Corning, Smart Photonics, Fraunhofer HHI
- a. 7th November 2022
 - b. PIC Summit Europe conference. <https://www.picsummiteurope.com/program/>
 - c. Located at the High Tech Center, Eindhoven, Netherlands
- 339) Invited speaker at PIC Summit Conference, Eindhoven, Netherlands in conjunction with IPSR conference to summarize panel findings and discussion with audience.
- a. 7th November 2022
 - b. PIC Summit Europe conference. <https://www.picsummiteurope.com/program/>
 - c. Located at the High Tech Center, Eindhoven, Netherlands
- 340) Invited Speaker and chair of datacom group at the PIC Summit Europe Conference and IPSR-I workshops with sessions entitled, ‘Paving the way to killer applications in 2035.’ located at TU/e Eindhoven University, Netherlands. Workshop 1c: Datacom roadmap for 2023.
- a. 8th November 2022
 - b. PIC Summit Europe conference and IPSR-I roadmap workshops. <https://www.picsummiteurope.com/program/>
 - c. Located at the TU/e Eindhoven University, Netherlands.
- 341) Invited talk: IEEE IPC (Integrated Photonics Conference) <https://ieee-ipc.org/industry-day/> as part of the conference <https://ieee-ipc.org> in the session Industry Day-Hot topics in industry. Talk entitled: “Enabling More Efficient Optical Networking using Ultra-high Speed, Ultra-low Power, Ultra-small Foundry based Polymer Modulators”
- a. 14th November 2022
 - b. IEEE IPC IEEE IPC (Integrated Photonics Conference) <https://ieee-ipc.org>
 - c. Located at the Hyatt Regency, Vancouver, BC, Canada.
- 342) Invited talk and panelist: IEEE IPC (Integrated Photonics Conference) <https://ieee-ipc.org/industry-day/> as part of the conference <https://ieee-ipc.org> in the session Roundtable on Topics in Entrepreneurship. Talk entitled: “Entrepreneur or Intrapreneur” with company CEOs that included: OEwaves, Polariton, Freedom Photonics/Luminar, Aeponyx, Octane Wireless.
- a. 14th November 2022
 - b. IEEE IPC IEEE IPC (Integrated Photonics Conference) <https://ieee-ipc.org>
 - c. Located at the Hyatt Regency, Vancouver, BC, Canada.
- 343) Invited Video presentation: Ladenburg Thalmann Virtual Technology Expo conference 2022 entitled “Investor Presentation for Ladenburg Thalmann virtual Technology Expo Investor Presentation”
- a. Video-taped on 29th November 2022 for release on 7th December 2022
 - b. For virtual attendees at the Thalmann Virtual Technology Expo conference 2022.

- c. Invited video presentation for virtual audience at 2022 Ladenburg Thalmann Virtual Technology Expo: <https://ladenburgtech22.sequireevents.com/>
- d. Presentation can be found at: <https://ladenburgtech22.sequireevents.com/>
- 344) Invited panelist: Photonics Spectra panel (virtual and recorded) titled, “Scaling PIC-based applications to volume production.” Panelists included representatives from Sicoya, Polariton, and Ligentec, and hosted by Dr. Jose Pozo, CTO Optica.
 - a. Recorded on 6th December 2022, for release 9-11th January 2023 (<https://events.photonics.com/Event.aspx?EID=9&OC=EM>)
 - b. Details on the event can be found at: <https://www.photonics.com/Advertise/MarketingBlog.aspx?AID=68312>
 - c. Hosted by Photonics Spectra (www.photonics.com)
- 345) Invited speaker at PhotonDelta’s Delta Dialogues virtual interview entitled, “Heterogeneous Integration for PICs” on the summary and findings of PIC Summit Europe conference on Heterogeneous Integration that took place in November 2022. The session was chaired by Jorn Smeets, PhotonDelta.
 - a. 7th December 6, 2022
 - b. Details of the event can be found at www.photondelta.com and <https://www.photondelta.com/events/> and <https://www.photondelta.com/events/delta-dialogues-december-2022/>
 - c. Hosted by PhotonDelta www.photondelta.com
- 346) Invited Panelist: Ladenburg Thalmann Virtual Technology Expo conference and presentation can be found at: <https://ladenburgtech22.sequireevents.com/>
 - a. 7th December 2022
 - b. For virtual attendees at the Thalmann Virtual Technology Expo conference 2022.
 - c. Invited investor presentation at 2022 Ladenburg Thalmann Virtual Technology Expo: <https://ladenburgtech22.sequireevents.com/>
- 347) Invited Webinar and panelist: Roth Capital Partners at the 11th Annual Roth Deer Valley Conference, (<https://www.roth.com/Page/Corporate-Access-Past-Conferences>) with Lightwave Logic investor presentation and meetings.
 - a. 14-16th December 2022
 - b. 11th Annual Roth Deer Valley Conference
 - c. Financial investment conference for public company review. Panelist for answering questions by bankers, investment specialists, and fund managers on Lightwave Logic and its business plans, technology and plans for the future.
- 348) Invited reviewer for European Commission program as part of the IPCEI (Important Project of Common European Interest) program on electronics and photonics.
 - a. Duration of review process Jun 2022 to Dec 2022
 - b. IPCEI (Important Project of Common European Interest) based on public funding.
 - c. IPCEIs are projects by the EU commission that have the potential to make important contributions to sustainable economic growth, jobs, competitiveness and resilience for industry and the economy in the Union as well as strengthen its open strategic autonomy, by enabling breakthrough innovation and infrastructure projects through cross-border cooperation and with positive spill-over effects on

the internal market and the society as a whole. In particular, semiconductor power FETs, laser diodes, amplifiers, FET technologies using both compound semiconductors (GaAs, GaN, InP) as well as silicon semiconductors (Silicon, SiGe) were reviewed.

2023

- 349) Reviewer: (European Commission) for project InSiDe
- 24th Jan 2023
 - Located at IMEC Ghent University facility, Ghent, Belgium
 - InSiDe is an EU project for PIC based technology in the medical field to monitor blood flow and artery stiffness in the human body using long wavelength lasers and silicon photonics. Hospital clinical trials will be conducted. It is a follow-on with more clinical trials from an initial CARDIS EU project.
 - <http://www.inside-h2020.eu>
- 350) Invited speaker and panelist for Laser Focus World Executive Forum (<https://www.laserfocusworld.com/executive-forum>) in San Francisco with talk entitled, “Hybrid integration with electro-optic polymers” and panel session entitled, “Enabling silicon photonics success”
- 30th January 2023
 - Details of the event can be found at <https://www.laserfocusworld.com/executive-forum> and agenda at <https://www.lfwexecutiveforum.com>
 - Panelists included: Jose Pozo, CTO Optica, David Piehler, Dell Technologies, Peter Winzer, Nubis Communications, Robert Blum, Intel
- 351) Interview with Benjamin Glick of Mergermarket magazine entitled, “Lightwave could acquire more assets ahead of commercialization—CEO”
- 3rd February 2023
 - Details of the interview can be found at: <https://community.ionanalytics.com/lightwave-could-acquire-more-assets-ahead-of-commercialization-ceo>
 - Video interview remotely from Lightwave Logic HQ in Englewood, Colorado.
- 352) Interview and podcast with Don Witt of Telecom Reseller’s Channel Daily News for a podcast on Lightwave Logic: Background, radical innovation, technology, acquisitions, world record results, goals, and the future of optical networking in a decade. Podcast can be found at <https://telecomreseller.com/2023/02/14/lightwave-logic-technology-enables-the-existing-fiber-internet-infrastructure-to-perform-3-times-faster-than-current-speeds-podcast/>
- 8th February 2023 (interview) and published 14th February 2023
 - Details can be found at: <https://telecomreseller.com/category/channel-daily-news/>
 - Podcast is with Telecom Reseller which provides information on voice mail, audio/video conferencing and peripherals, association and industry news,

- services, applications, and related topics of daily importance to telecommunications professionals.
- 353) Invited Article entitled: “The Internet Is the Brick Wall Nostradamus Didn’t See Coming” with sub-heading, “The road maps Lightwave Logic is creating for the future of photonics will guide people toward the focus areas and the technology challenges they can expect as performance demands increase.” For the industry trends section of BBC magazine (Broadband Communities) at (<https://www.bbcmag.com>)
- Published in Broadband Communities 14th February 2023.
 - Article can be found at: https://www.bbcmag.com/pub/doc/BBC_Jan23_BrickWall.pdf
- 354) Interview with AlphaStreet entitled, “Lightwave Logic will license technology to make its polymers ubiquitous: CEO Dr. Michael Lebby” Interview can be found at <https://news.alphastreet.com/lightwave-logic-will-license-technology-to-make-its-polymers-ubiquitous-ceo-dr-michael-lebby/>
- 6th March 2023 (interview) and published 10th March 2023
 - Details can be found at: <https://news.alphastreet.com/lightwave-logic-will-license-technology-to-make-its-polymers-ubiquitous-ceo-dr-michael-lebby/>
 - Interview is with AlphaStreet which provides financial information on companies and utilize NLP and AI techniques in the research industry.
- 355) Invited speaker: Roth Capital Partners 35th Annual Roth Conference (<https://www.roth.com/Page/Corporate-Access-Past-Conferences>)
- 13th Mar 2023
 - 35th Annual Roth Conference (www.roth.com/oc2023)
 - Financial investment conference for public company review. Panelist for answering questions by bankers, investment specialists, and fund managers on Lightwave Logic and its business plans, technology and plans for the future.
- 356) Interview with Laser Focus by Jose Pozo as part of his Industry Executive interviews for the photonics industry. Key topics included intrapreneur and entrepreneur experience, Lightwave Logic, photonics experience, OIDA, roadmapping, and key drivers for a career in photonics integration Interview can be found at: <https://www.laserfocusworld.com/fiber-optics/article/14293915/how-thinking-ahead-shaped-the-fiberoptics-industry>
- 16th March 2023 (interview) and published 17th May 2023
 - Details can be found at: <https://www.laserfocusworld.com>
 - Interview is with Laser Focus World which was originally published in 1965, as *Laser Focus World*—a monthly magazine for engineers, researchers, scientists, and technical professionals—provides comprehensive global coverage of optoelectronic technologies, applications, and markets. Nearly 70,000 qualified optoelectronics professionals from around the world currently subscribe.
- 357) Interview with IDC by Brandon Hoff on Lightwave Logic, background, radical innovation, proprietary electro-optic polymer technology, goals and why the company is planning on making polymers ubiquitous for the hyper-scaler, datacenter markets.

- a. 16th March 2023 (interview)
 - b. Details can be found at: <https://www.idc.com>
 - c. Interview is with IDC which provides market and financial information on the information technology and optical networking industry.
- 358) Invited article for ISE entitled “ Proactive Powering Problem-Solving with Polymers” <https://www.isemag.com/fttx-optical-networks/article/14290981/proactive-powering-problemsolving-with-polymers>
- a. 16th March 2023
 - b. Details can be found at: <https://www.isemag.com>
 - c. ISE has articles on IT solutions and education.
- 359) Invited article and interview (from panel discussion) at Laser Focus World Executive Forum (<https://www.laserfocusworld.com/executive-forum>) in San Francisco with article entitled, “Silicon photonics: Is it witchcraft?” <https://www.laserfocusworld.com/executive-forum/article/14290913/silicon-photonics-is-it-witchcraft>
- a. 17th March 2023
 - b. Details of the event can be found at <https://www.laserfocusworld.com/executive-forum> and agenda at <https://www.lfwexecutiveforum.com>, and article at: <https://www.laserfocusworld.com/executive-forum/article/14290913/silicon-photonics-is-it-witchcraft>, written by Sally Cole Johnson for Laser Focus.
 - c. Panelists included: Jose Pozo, CTO Optica, David Piehler, Dell Technologies, Peter Winzer, Nubis Communications, Robert Blum, Intel
- 360) Invited article for IMS expert insights entitled, “An Expert Witness Perspective on Inter Partes Review of Patents” by Dr. Michael Lebby, IMS Elite Expert, <https://www.expertservices.com/insight/expert-witness-ipr-patents/>
- a. 12th April 2023
 - b. Details can be found at <https://www.expertservices.com>
 - c. Patent litigation cases can be won or lost through the actions and competency of an expert witness—making their role not only important but crucial. The article takes a closer look at the part an expert witness plays during the *inter partes* review and considers how the IPR process could be improved.
- 361) Invited interview with Semiconductor Engineering by Karen Heyman, in an article called <https://semiengineering.com/transitioning-to-photonics/> entitled, “Transitioning to Photonics”
- a. Interview taken on 4th April 2023 and published online 14th April 2023
 - b. Details can be found at: <https://semiengineering.com/about-us/>
 - c. The article is based on the premise that high speed and low heat make photonics technology essential, especially compared to electronics, but it’s extremely complex, and talent is hard to find and train.
- 362) Session Co-chairman: 8th PIC International conference, www.picinternational.net
- a. 17-18th April 2023 for 2 days of PIC sessions.
 - b. Conference hosted by Angel events together with CS International and Power Electronics International conferences.

- c. Sheraton Airport Hotel, Brussels, Belgium.
- 363) Chair Panel session: For the panel entitled, “Foundry models for PICs” of 8th PIC International conference, www.picinternational.net and moderated by Jose Pozo, CTO Optica. Panel members included Global Foundries, Tower, VTT
 - a. 17th April 2022
 - b. Conference hosted by Angel events together with CS International, and Power Electronics International conferences.
 - c. Sheraton Airport Hotel, Brussels, Belgium.
- 364) Invited speaker and oral presentation: With presentation entitled, “Positioning electro-optic polymer modulators as an optical engine to extend data rate and low power performance for optical networking” at the 8th PIC International conference, www.picinternational.net in the day 2 session, “Scaling PICs in volume using foundries”
 - a. 18th April 2023
 - b. Conference hosted by Angel events together with CS International, and Power Electronics International conferences.
 - c. Sheraton Airport Hotel, Brussels, Belgium.
- 365) Invited speaker: “Status of Lightwave Logic and electro-optic polymers” at the Cleydael Golf Club, Antwerp, Belgium (www.cleydael.be)
 - a. 18th April 2023
 - b. Meeting organized by Belgium and Dutch retail investors of Lightwave Logic Inc. (NASDAQ:LWLG)
 - c. Location: Belgium
- 366) Invited interview with Semiconductor Engineering by Karen Heyman, in an article called <https://semiengineering.com/new-standards-push-co-packaged-optics/> entitled, “New standard push co-packaged optics”
 - a. Interview taken on 4th April 2023 and published online 26th April 2023
 - b. Details can be found at: <https://semiengineering.com/about-us/>
 - c. The article is based on the premise that co-packaged optics (CPOs) promises five times the bandwidth of pluggable connections, however, the new architecture requires multiple changes to accommodate different applications, and if the design is efficient the optical engines will be able to impact both on-board optics as well as pluggable transceivers.
- 367) Invited speaker and oral presentation for the Sequire Investor Summit, San Juan, Puerto Rico. The presentation was entitled, “LWLG April 2023 investor presentation” with link <https://puertorico.srax.com> with agenda: <https://schedule.puertorico.srax.com>
 - a. Conference on 25th and 26th April 2023 with presentation on 25th April 2023
 - b. Link to website for Sequire event: <https://puertorico.srax.com>
 - c. Investor conference at the La Concha hotel San Juan, Puerto Rico.
- 368) Invited speaker and oral presentation: Ladenburg Thalmann Technology Expo and conference 2023. The presentation was entitled, “LWLG April 2023 investor presentation” and can be found at: https://www.meetmax.com/sched/event_94169/_co-list_cp.html
 - a. 27th April 2023

- b. The conference and expo 2023, was held at Convene Hotel, Park and 41st, New York, New York and can be found at:
https://www.meetmax.com/sched/event_94169/_co-list_cp.html and also at
<https://www.ladenburg.com/investment-banking/ladenburg-thalmann-co-inc->
 - c. The 2023 Expo featured presentations from the managements of approximately 50-60 public and private technology companies covering Media and Content-Tech, Software and Service-Tech, and Hardware and Defend-Tech.
- 369) Invited article: 8th PIC International conference overview entitled, “An overview of Angeltech 2023 (PIC international conference)”, which can be found at
www.picinternational.net with newsletters@angelmail.co.uk
- a. 2nd May 2023
 - b. Overview is based on the results of the PIC International Conference hosted by Angel events (17-18th April 2023) together with CS International and Power Electronics International conferences.
 - c. Sheraton Airport Hotel, Brussels, Belgium.