UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.
Petitioner

v.

LYNK LABS, INC.
Patent Owner

Patent No. 10,750,583

PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 10,750,583

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I. INTRODUCTION

Samsung Electronics Co., Ltd. ("Petitioner" or "Samsung") requests *inter partes* review of claims 1-7, 11, 12, and 14 ("challenged claims") of U.S. Patent No. 10,750,583 ("the '583 patent") (Ex. 1001) assigned to Lynk Labs, Inc. ("PO"). For the reasons below, the challenged claims should be found unpatentable and canceled.

II. MANDATORY NOTICES

Real Parties-in-Interest: Petitioner identifies the following as the real parties-in-interest: Samsung Electronics Co., Ltd., Samsung Electronics America, Inc.

Related Matters: The '583 patent is at issue in the following matters:

- *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, No. 1-21-cv-02665 (N.D. Ill.) (seeking declaratory judgment of non-infringement as to the '583 patent and also U.S Patent Nos. 11,019,697, 10,506,674, 10,492,252, 10,499,466, 10,966,298, 10,492,251, 10,687,400, 10,517,149, 10,154,551, and 10,652,979) ("Illinois Litigation").

The '583 patent claims priority to, *inter alia*, two provisional applications (U.S. Provisional Application Nos. 60/547,653 filed February 25, 2004 and 60/559,867 filed April 6, 2004. The following patents claim the same benefit of priority to the '653 and '867 applications and have corresponding IPR proceedings:

- U.S. Patent No. 8,531,118 at issue in *Acuity Brands Lighting, Inc., v. Lynk Labs, Inc.*, IPR2016-01133 (terminated);
- U.S. Patent No. 10,506,674 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01299 (pending);
- U.S Patent No. 11,019,697 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01300 (pending);
- U.S Patent No. 10,492,252 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01345 (pending);
- U.S Patent No. 10,499,466 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01346 (pending);
- U.S Patent No. 10,966,298 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01347 (pending);
- U.S Patent No. 10,652,979 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01576 (pending);
- U.S Patent No. 10,154,551 at issue in *Home Depot USA, Inc. v. Lynk Labs, Inc.*, IPR2021-01367 (pending) and *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01575 (pending).
- U.S. Patent No. 10,492,251 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2022-00051 (pending), *Samsung Electronics Co., Ltd. v. Lynk*

Labs, Inc., IPR2022-00052 (pending), and *The Home Depot USA, Inc. et al. v. Lynk Labs, Inc.*, IPR2021-01369 (pending);

- U.S Patent No. 10,517,149 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2022-00098 (pending), and *The Home Depot USA, Inc. et al. v. Lynk Labs, Inc.*, IPR2022-00023 (pending).

Counsel and Service Information: Lead counsel: Naveen Modi (Reg. No. 46,224), and Backup counsel are (1) Joseph E. Palys (Reg. No. 46,508), (2) Arvind Jairam (Reg. No. 62,759), (3) Mark Consilvio (Reg. No. 72,065), (4) Howard Herr (*pro hac vice* admission to be requested). Service information is Paul Hastings LLP, 2050 M St., Washington, D.C., 20036, Tel.: 202.551.1700, Fax: 202.551.1705, email: PH-Samsung-LynkLabs-IPR@paulhastings.com. Petitioner consents to electronic service.

Petitioner is concurrently filing another IPR petition challenging claims of the '583 patent.[1]

[1] Petitioner concurrently submits a separate paper (consistent with the Trial Practice Guide Update, July 2019), explaining why the filing of multiple petitions should not be a basis for discretionary denial under 35 U.S.C. § 314.

III. PAYMENT OF FEES

The PTO is authorized to charge any fees due during this proceeding to Deposit Account No. 50-2613.

IV. GROUNDS FOR STANDING

Petitioner certifies that the ’583 patent is available for review and Petitioner is not barred or estopped from requesting review on the grounds identified herein.

V. PRECISE RELIEF REQUESTED AND GROUNDS

Claims 1-7, 11, 12, and 14 should be canceled as unpatentable based on the following grounds:

Ground 1: Claims 1, 3, and 5-6 are unpatentable under pre-AIA 35 U.S.C. § 103(a) as being obvious over *Shackle* (Ex. 1021), *Birrell* (Ex. 1014), and *Schultz* (Ex. 1032);

Ground 2: Claim 7 is unpatentable under pre-AIA 35 U.S.C. § 103(a) as being obvious over *Shackle*, *Birrell*, *Schultz*, and *Smith* (Ex. 1019);

Ground 3: Claims 2 and 4 are unpatentable under § 103(a) as being obvious over *Shackle*, *Birrell*, *Schultz,* and *Salam* (Ex. 1015); and

Ground 4: Claims 11, 12, and 14 are unpatentable under pre-AIA 35 U.S.C. § 103(a) as being obvious over *Shackle* and *Piepgras* (Ex. 1030).

The ’583 patent issued August 18, 2020 from Application No. 16/449,273 filed June 21, 2019, and claims priority via a chain of applications to eight provisional applications. Petitioner does not concede that the ’583 patent is entitled to any of the claimed priority applications, but for purposes of this proceeding only, assumes the critical date for the ’583 patent is February 25, 2004, which is the earliest date of eight provisional applications.

Birrell published July 17, 2003, and thus qualifies as prior art under pre-AIA 35 U.S.C. § 102(a).

Smith issued December 3, 2002, and *Michael* issued April 7, 1987, and thus each qualifies as prior art under pre-AIA 35 U.S.C. § 102(b).

Schultz was published June 2, 2005 from an application filed December 2, 2003, and *Shackle* issued on March 28, 2006 from an application filed July 29, 2003, and thus each qualifies as prior art at least under pre-AIA 35 U.S.C. § 102(e).

Piepgras was filed September 17, 2002 and issued July 24, 2003, and *Salam* was filed March 30, 2001 and issued October 14, 2003, and thus each qualifies as prior art at least under §§ 102(a) and/or (e).

Apart from *Shackle* (addressed below in §X.B), none of these references were considered during prosecution. (Ex. 1001, References Cited; *see generally* Ex. 1004.)

VI. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art as of the claimed priority date of the ’583 patent (“POSITA”) would have had at least a bachelor’s degree in electrical engineering, computer engineering, computer science, physics, or the equivalent, and two or more years of experience with LED devices and/or related circuit design, or a related field. (Ex. 1002, ¶¶20-21.)[2] More education can supplement practical experience and vice versa. (*Id.*)

VII. OVERVIEW OF THE '583 PATENT

While the '583 patent purports to identify an invention directed to an LED device/system having various features (*e.g.,* Ex. 1001, 4:25-10:67, 13:34-67), the claims are broadly directed to a lighting device having a combination of known components and features (*id.*, 28:19-29:4). The '583 patent was allowed on first action during prosecution (Ex. 1004, 133-139), with the Examiner providing a statement of reasons for allowance that **does not even relate to any of the issued claims** (*compare* Ex. 1004, 138, *with* Ex. 1001, 27:17-28:37). After the first Notice of Allowance, the Examiner issued a Corrected Notice of Allowability (Ex. 1004, 185-186), and then issued another Corrected Notice of Allowability that included an unexplained Examiner's Amendment (*id.*, 197-200). However, even with the Examiner's Amendment, the claims merely recite assorted combinations of features already known in the prior art, which does not impart patentability. *See In re*

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[2] Petitioner submits the declaration of R. Jacob Baker, Ph.D., P.E. (Ex. 1002), an expert in the field of the '583 patent. (Ex. 1002, ¶¶1-19; Ex. 1003.)

Gorman, 933 F.2d 982, 986 (Fed. Cir. 1991) ("The criterion ... is not the number of references, but what they would have meant to a person of ordinary skill in the field of the invention."). (*Infra* §IX; Ex. 1002, ¶¶54-56, 58-85; *see also id.*, ¶¶22-53 (citing, *inter alia*, Exs. 1011, 1012, 1014, 1017, 1018, 1030, 1031, 1034, 1041, 1042, 1043, 1044, 1045, 1088, 1089, 1090, 1091, 1092, 1093, and 1094; *see generally* Ex. 1004, Exs. 1051-1070.)

VIII. CLAIM CONSTRUCTION

The Board only construes the claims when necessary to resolve the underlying controversy. *Toyota Motor Corp. v. Cellport Systems, Inc.*, IPR2015-00633, Paper No. 11 at 16 (Aug. 14, 2015) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)). For purposes of this proceeding, Petitioner believes that no special constructions are necessary to assess whether the challenged claims are unpatentable over the asserted prior art.[3] (Ex. 1002, ¶57.)

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[3] Petitioner reserves all rights to raise claim construction and other arguments, including challenges under 35 U.S.C. §§ 101 or 112, in district court as relevant to those proceedings. *See*, *e.g.*, *Target Corp. v. Proxicom Wireless, LLC*, IPR2020-00904, Paper 11 at 11–13 (November 10, 2020). A comparison of the claims to any accused products in litigation may raise controversies that are not presented here given the similarities between the references and the patent.

IX. DETAILED EXPLANATION OF GROUNDS

A. Ground 1: Claims 1, 3, and 5-6 Are Obvious over *Shackle* in View of *Birrell* and *Schultz*

1. Claim 1

a) An LED lighting device comprising:

To the extent limiting, *Shackle* discloses/suggests the preamble of claim 1. (Ex. 1002, ¶¶58-75, 86-88.) *Shackle* discloses an "LED drive[r] that includes an LED current generating circuit and an LED drive controller" to drive an LED light source 18. (Ex. 1021, 1:50-53; *id.*, FIGS. 1-2, 4 (below), 1:5-17, 2:16-26, 2:45-3:34, 6:4-7:14, 7:24-52.)

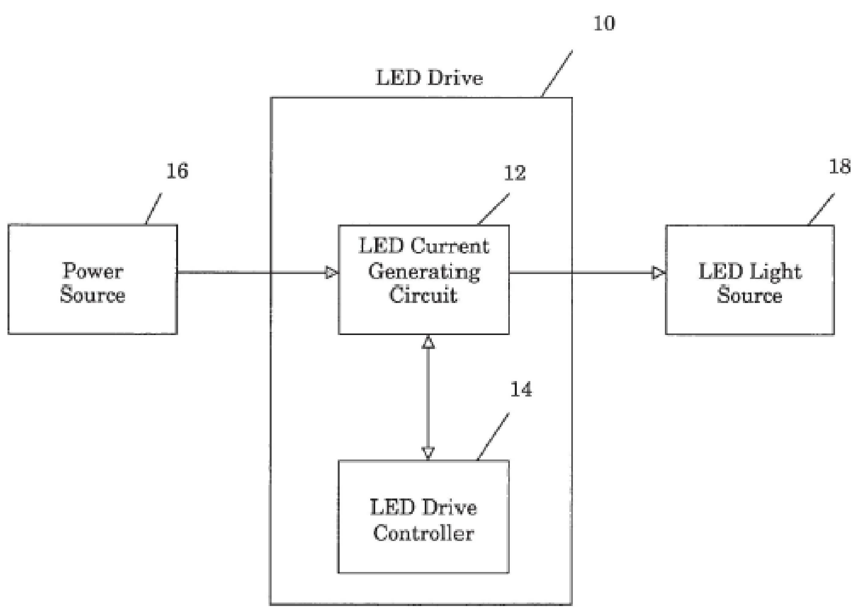

Fig. 1

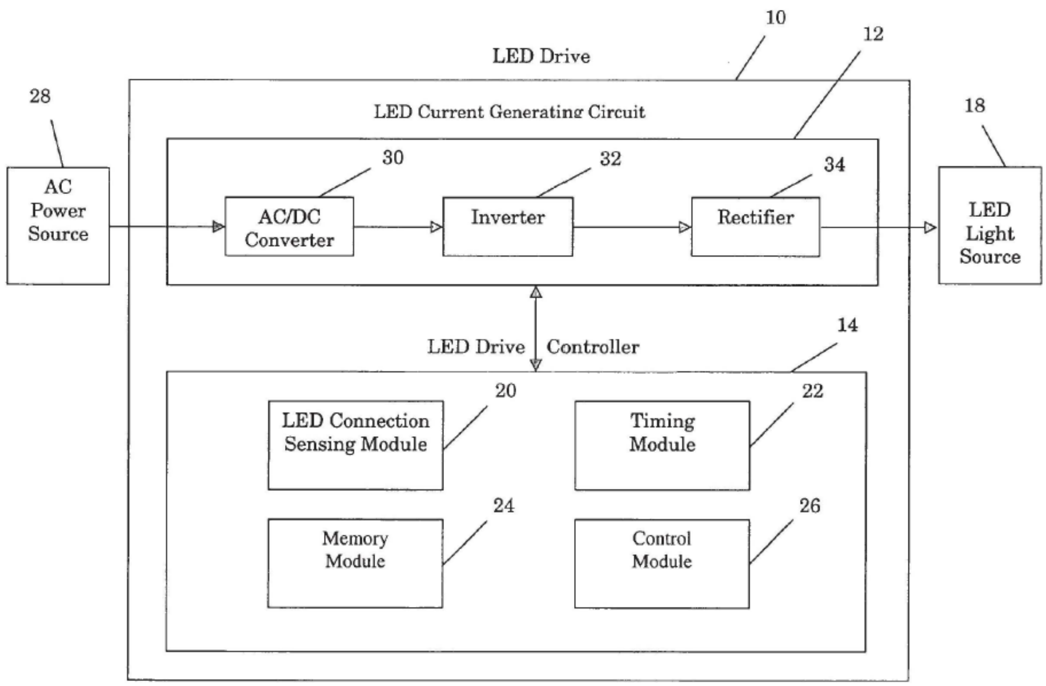
10
12
LED Drive
LED Current Generating Circuit
28
18
30
32
34
AC Power Source
AC/DC Converter
Inverter
Rectifier
LED Light Source
14
LED Drive Controller
20
22
LED Connection Sensing Module
Timing Module
24
26
Memory Module
Control Module

Fig. 2

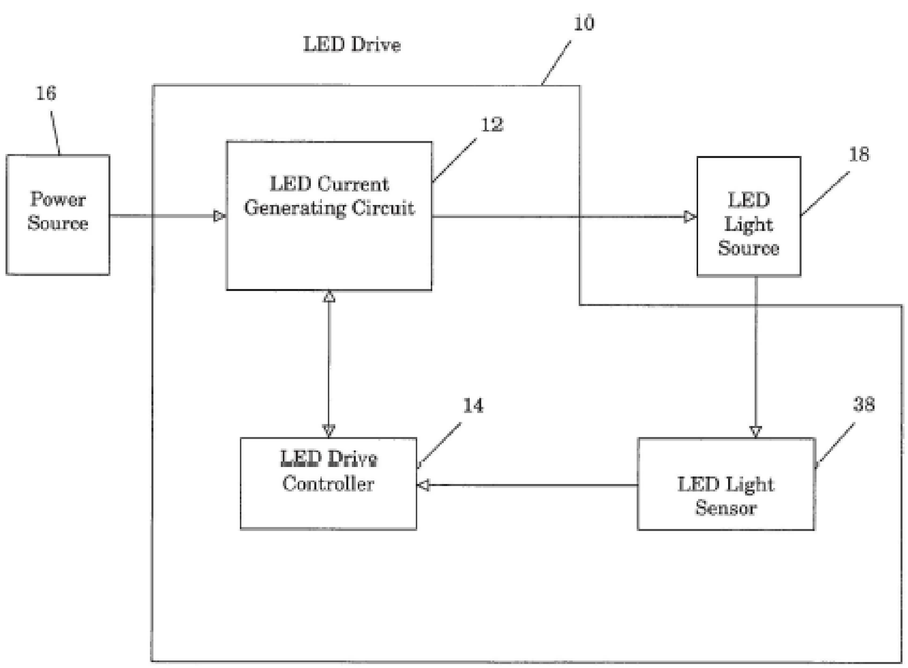
10
LED Drive
16
12
18
Power Source
LED Current Generating Circuit
LED Light Source
14
38
LED Drive Controller
LED Light Sensor

Fig. 4

For example, the above illustrated configurations each disclose an "LED lighting device," as claimed, including an LED light source 18. (Ex. 1002, ¶88.) In particular, *Shackle* discloses a device, *e.g.*, stating that "**this invention** pertains to a **device** that can be used to control the light output of a light emitting diode light source." (Ex. 1021, 1:8-10; *id.*, 1:6-8, 1:42-46 (describing a "device that can be used with an LED traffic device"); Ex. 1002, ¶88.)[4] Nonetheless, to the extent *Shackle* is deemed not to explicitly disclose an LED lighting device (*e.g.*, light source 18 is deemed to be a separate "device"), it would have been obvious in view of *Shackle* to implement an LED lighting *device* as claimed. A POSITA would have been motivated and found obvious to configure the components described in connection with FIGs. 1-2, 4 as a "device" because it would have provided a combined arrangement of components including an LED light source with drive circuitry for providing proper illumination that would have added versatility to implementing the device in the applications contemplated by *Shackle*. (Ex. 1002, ¶88; Ex. 1021, 6:15-23.) A POSITA would have known how to combine such components to form a composite device especially given such configuration would have been a combination of known technologies/techniques to predictably produce an LED lighting device that operates consistent with that disclosed by *Shackle*. (*Id.*) *KSR*

[4] Emphasis added unless indicated otherwise.

Int'l Co. v. Teleflex Inc., 550 U.S. 398, 416 (2007). Accordingly, a POSITA would have had a reasonable expectation of success implementing the above configuration. (*Id.*; §§IX.A.1(b)-(f).)

b) an LED driver having an input and an output, wherein the input is configured to receive an AC voltage source, and wherein the output provides an AC voltage or a DC voltage;

Shackle discloses this limitation. (Ex. 1002, ¶¶89-90.) For example, *Shackle*'s LED drive 10 ("LED driver") includes an **input** (red below) that receives an AC voltage ("AC voltage source") and a DC voltage **output** to LED light source 18 ("an AC voltage or a DC voltage"). (Ex. 1021, FIGS. 1, 2, 4, 6:15-16 ("power source 16 may be an **ac power source**…"), 6:24-27 (generating circuit 12 varies depending upon the type of power source 16 used and that LED drive 10 in FIG. 2 is used with "an **ac power source** 28.").)

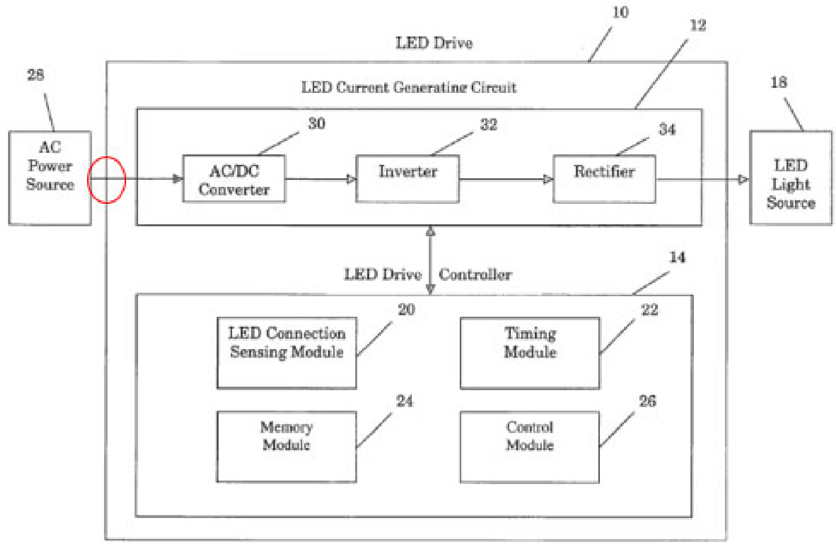

Fig. 2

(Ex. 1021, FIG. 2 (annotated); Ex. 1002, ¶89.)

LED current generating circuit 12 (within LED drive 10) "includes an AC/DC converter 30" adapted to "convert a **low frequency ac power signal, e.g., typically 120 volts at 60 Hz, to a dc power signal**…." (*Id.*, 6:27-32; *id.*, 7:9-13 (converter 30 is a "full-bridge rectifier" that "operates in a manner that is similar to that of the rectifier 34 as described above"), 6:60-7:5 (describing rectifier 34), 2:2-5 (rectifier 34 operable to convert inverter's ac signal to a "dc power signal" that is applied to an LED light source); Abstract ("[T]he drive controller ... uses [a] light signal to control the **dc** current output."), 3:10-14 (LED current generating circuit 12 provides "a **dc** current signal and … a dc power signal"), 6:35-41, 7:3-5 ("The dc power signal can then be used to supply the dc current signal to the LED light source 18."); Ex. 1002, ¶90.) A POSITA would have understood that *Shackle*'s dc power signal output by LED drive 10 includes a DC voltage, because power is current multiplied by voltage. (Ex. 1002, ¶90.)

c) at least one LED circuit having any number of LEDs connected in series or series parallel needed to approximately match the forward voltage drop of a first input voltage to the LED driver;

Shackle in view of *Birrell* discloses/suggests this limitation. (Ex. 1002, ¶¶91-99.) As discussed, *Shackle* discloses an LED light source 18 (shown in block diagram format in FIGS. 1-2, 4. (§IX.A.1(a); Ex. 1002, ¶91.)

While *Shackle* does not describe the internal components of LED light source 18, a POSITA would have understood that LEDs and associated lighting circuitry were well known and thus would have known how to implement the LEDs in light source 18 according to various arrangements suited for the applications contemplated by *Shackle*. (Ex. 1002, ¶92; Ex. 1021, 6:15-23.) Indeed, a POSITA would have understood that LED light source 18 necessarily includes at least one LED *circuit* because LEDs require current (and hence power) to emit light, and a circuit is required in order for current to flow (and for power to be supplied). (Ex. 1041, ¶¶[0241] ("Typical LED performance characteristics depend on the amount of current drawn by the LED."), [0242]-[0243], [0254]; Ex. 1042, 99; Ex. 1043, ¶[0004] ("LEDs are semiconductor devices that produce light when a current is supplied to them. ..."); Ex. 1002, ¶¶35, 40, 44, 92.) *Shackle* even discloses that **LED current generating** circuit 12 provides current to the LED light source, confirming that LED light source 18 must include an LED circuit to receive and use the current for illumination consistent with known LED operation. (*Id.*; Ex. 1021, FIG. 1, 2:2-5, 2:59-63.)

Nonetheless, to the extent *Shackle* does not explicitly disclose that LED light source includes "at least one LED *circuit*" that has *any number of LEDs connected in series or series parallel needed to approximately match the forward voltage drop of a first input voltage to* LED drive 10 ("LED driver"), it would have been obvious in view of *Birrell* to implement such features. (Ex. 1002, ¶93.) *Birrell*, like *Shackle*, relates to an LED lighting system. (Ex. 1014, 2:3-8 ("systems … for connecting electrical devices to power sources" for illuminating areas), Abstract, FIGS. 1-3, 8-10; Ex. 1002, ¶94.) Figure 8 (below) shows an exemplary LED lighting system including LEDs 59 coupled to a 48 AC voltage source via a rectifier (diodes 67) and a capacitive coupling (capacitors C_A and C_B). (Ex. 1014, FIG. 8, 19:1-7 (bridge rectifier 67 ensures "light is emitted from the LEDs during both the positive and negative cycles of the AC power supply coupled via capacitors…"), 20:26-31, 20:32-23:29.)

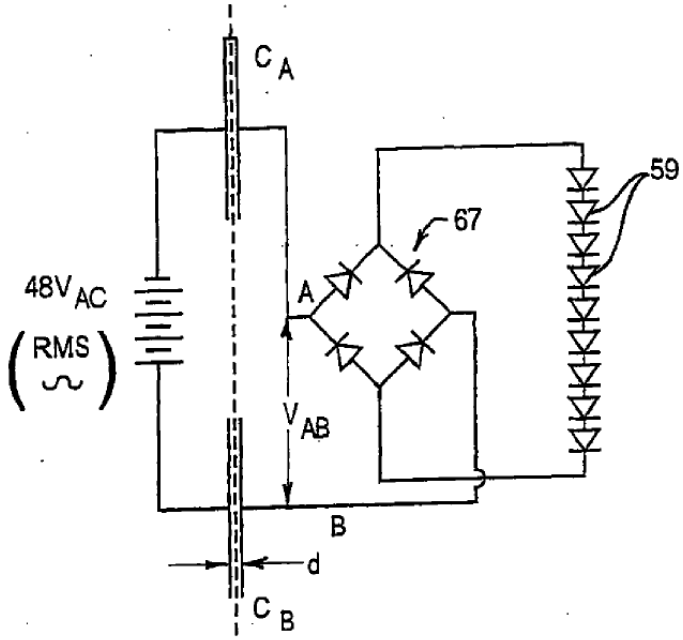

FIG 8

Birrell's FIGS. 1-4 arrangements associated with the FIG. 8 circuit also show LEDs 59, which may be implemented on a lighting tile 50. (Ex. 1014, 14:26-15:33, FIG. 1 (below), 15:34-18:12, FIG. 4, 18:17-20:6.)

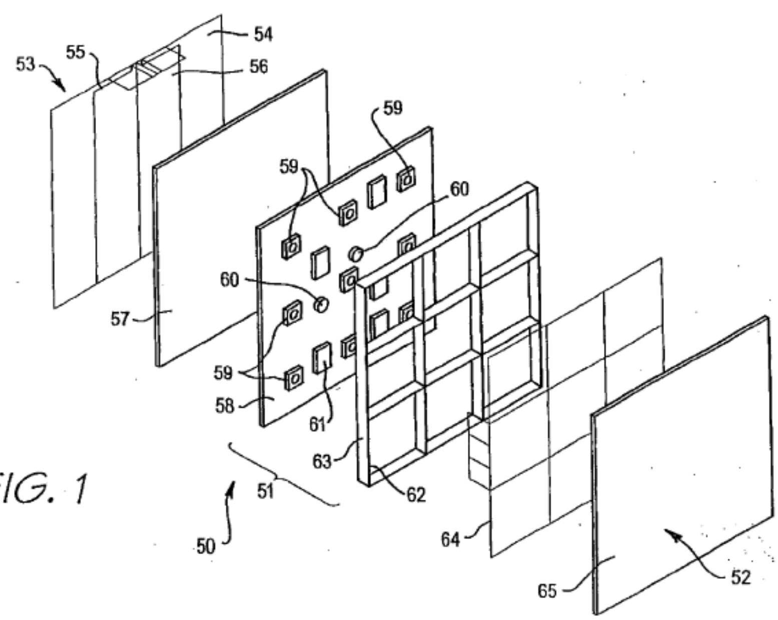

FIG. 1

Birrell discloses that the application of voltage matching principles (like that recited in limitation 1(c)) was known in the context of an LED circuit. (Ex. 1002, ¶95.) *Birrell* describes that the voltage across each of the nine LEDs 59 in FIG. 8 is 3.5 V. (Ex. 1014, 20:26-31 ("nine LEDs"), 22:9-30 ("the voltage drop VAB will be 1.5 volts for diodes 67 plus 3.5 volts each for [nine] LEDs 59").) The "[t]otal voltage drop VAB will be 33 volts" (Ex. 1014, 22:9-13), which a POSITA would have recognized because 1.5V + (9 LEDs × 3.5V) = 33 V. (Ex. 1002, ¶95.) *Birrell* explains that capacitors C_A and C_B have a voltage drop of 7.5 volts each and "a 48 Volt AC power supply ... will satisfactorily illuminate the [LEDs] of Figure 8." (Ex. 1014, 22:13-18, 22:29-30, FIG. 8.) A POSITA would have recognized that such teachings in *Birrell* are a straightforward application of the well-known circuit principle known as Kirchhoff's Voltage Law, which requires that the sum of the voltage drops of various elements around a circuit must equal zero. (Ex. 1002, ¶95.)

A POSITA would have understood that a portion of the Figure 8 arrangement includes (or operates as) an LED driver (*e.g.*, annotated below in blue) that drives current (and power) to LEDs 59.

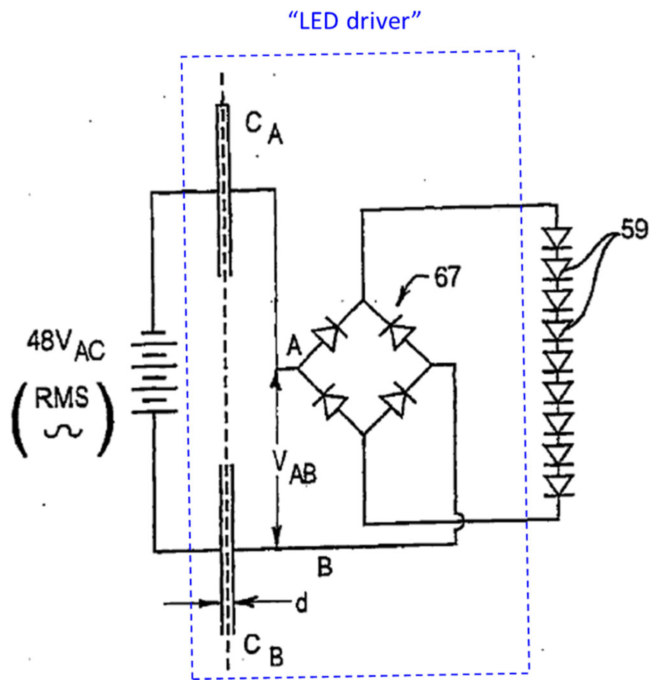

FIG 8

(Ex. 1002, ¶96.) Thus, a POSITA would have understood that *Birrell* discloses an LED circuit having nine series-connected LEDs 59 that is needed to approximately match the forward voltage drop of a first input voltage (48V, because 33V + (2 × 7.5V) = 48V) to the LED driver. (Ex. 1002, ¶97.)

In light of *Birrell* and the state of the art knowledge of a POSITA, a POSITA would have been motivated, and found it obvious, to implement known LED circuit design principles to configure *Shackle*'s LED circuit to include an appropriate number of LEDs connected in series or series parallel as needed to approximately match the forward voltage drop of a first input voltage to the above-discussed LED driver for limitation 1(b). (Ex. 1002, ¶98.) Such a configuration would have been useful for operating *Shackle*'s LED lighting device correctly (*e.g.*, for illuminating the LEDs without overdriving or underdriving them, which may lead to LED damage or sub-optimal illumination). (Ex. 1002, ¶98; Ex. 1026, 6:6-9.) A POSITA would have been skilled at circuit design/implementation and thus been motivated to implement such features, especially since such a configuration would have been a straightforward application of known circuit design principles and technologies, as guided by, *e.g.*, *Birrell*, that would have predictably led to a properly operating LED lighting device as contemplated by *Shackle*. (Ex. 1002, ¶99.) As such, a POSITA would have had a reasonable expectation of success implementing such a modification configuration in *Shackle*'s device. (*Id.*) *KSR*, 550 U.S. at 416.

d) wherein the LED driver comprises a high frequency stage, the high frequency stage providing an inverter and an output frequency higher than an AC mains input frequency to the LED driver;

Shackle (as modified above) this limitation. (Ex. 1002, ¶¶100-102.) LED drive 10 ("LED driver") comprises a high frequency stage with an inverter 32 (red below) that provides an output frequency that is higher than an input frequency from AC power source 28 ("an AC mains input frequency"). (*Id.*, ¶100.)

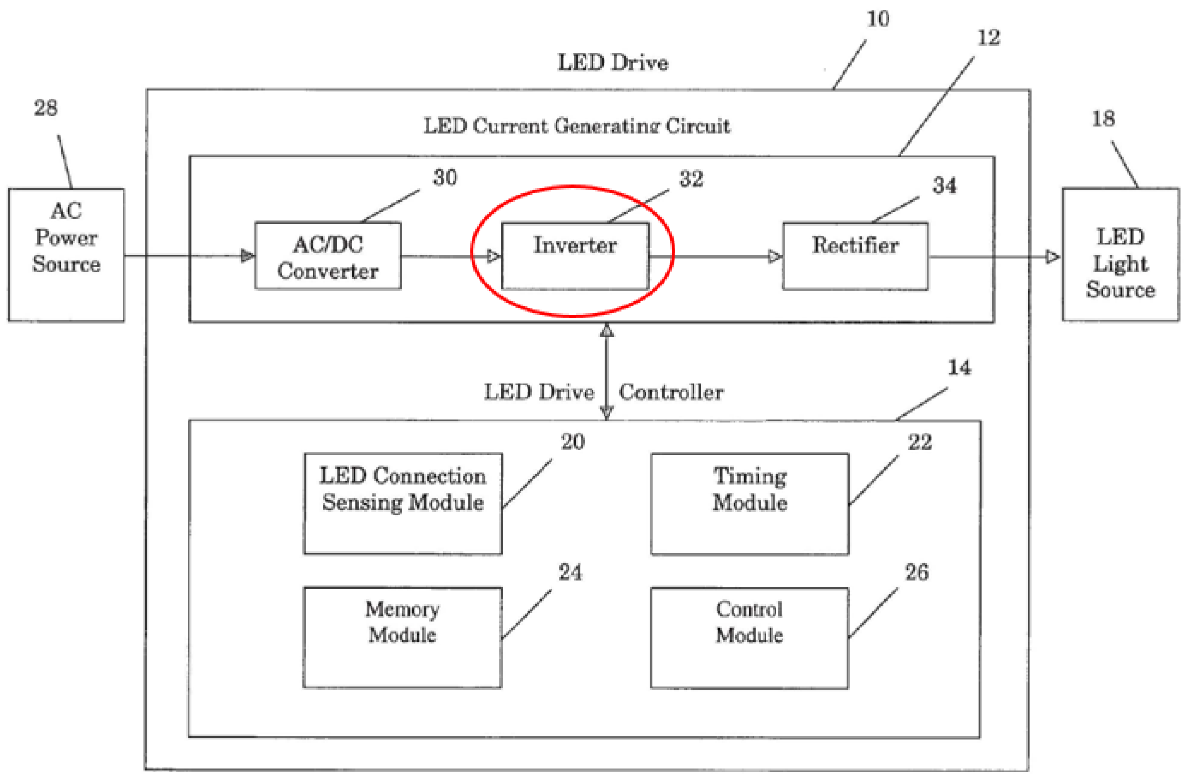

Fig. 2

(Ex. 1021, FIG. 2 (annotated).)

Shackle explains that AC/DC converter 30 that "is adapted to convert a **low frequency** ac power signal, *e.g.*, typically 120 volts at **60 Hz**, to a dc power signal…." (Ex. 1021, 6:27-32.) Inverter 32 converts the received dc power signal "into a **high frequency** ac power signal, **typically 25-60 kHz**." (*Id.*, 6:29-34.) The high frequency ac power signal is provided to rectifier 34, which "is adapted to convert the **high frequency** ac power signal into the dc current signal used to supply power to the LED light source 18." (*Id.*, 6:35-38.) Inverter 32 may be a half-bridge rectifier (*id.*, 6:42-44) "well-known in the art" (6:44-59) or "other types of inverters capable of generating a high frequency ac power signal output may be used" (*id.*, 6:57-59). (Ex. 1002, ¶101.)

A POSITA would have understood that the AC input frequency provided by AC power source 28 (Ex. 1021, FIG. 2) to LED drive 10 is an AC *mains* input frequency. (Ex. 1002, ¶102; Ex. 1021, 6:27-32 ("typically **120 volts at 60 Hz**"); Ex. 1013, 1:25-29 ("a.c. **mains (120 v.a.c., 60 Hz)**"); Ex. 1027, 1:8-12 (AC "from a commercial power line" and "AC mains"), 1:18-23).)[5] Thus, *Shackle*'s drive 10 ("LED driver") comprises a high frequency stage providing inverter 32 and an output frequency (*e.g.*, 25-60 kHz) higher than an AC mains input frequency (*e.g.*, 60 Hz) to drive 10. (Ex. 1002, ¶102.)

e) a transistor, wherein the transistor is operable to control a current flow to the at least one LED circuit;

Shackle discloses/suggests this limitation. (Ex. 1002, ¶¶103-108.) LED drive controller 14 (Ex. 1021, FIGS. 1-2, 4) controls a current flow to LED light source 18. (*Id.*, 2:65-3:6 ("LED drive controller 14 is adapted to **control the power signal and, as a result, the current signal**, output by the LED current generating circuit 12 so that the effective light output of the LED light source 18 remains approximately constant … so that the LED light source 18 can be used for its intended purpose."); *id.*, Abstract, 1:56-61.)

[5] PO asserted that a 120V source is a "mains" power source. (Ex. 1072, 12-13.)

LED drive includes a microcontroller (*id.*, 1:62-64) "operable to automatically increase the dc power signal, and as a result, the dc current signal, applied to the LED light source … to ensure … effective light output of the LED array" (*id.*, 2:6-11). (*Id.*, 2:45-48, 2:51-55 ("LED drive controller 14 may alternatively be referred to as an LED voltage controller, an LED current controller, an LED power controller, or simply an LED controller."); Ex. 1002, ¶104.) "LED drive controller 14 ... is designed to control the current signal output by the LED current generating circuit 12 in several different ways," including an "open loop control scheme," a "closed loop control scheme" (*e.g.*, via feedback signals), and "a combination of" both schemes. (Ex. 1021, 3:15-34; Ex. 1002, ¶104.) (*See also* Ex. 1021, 5:4-23 (controller 14 controls starting/stopping current supplied to light source 18), 5:24-39.)

A POSITA would have understood that the current signal supplied by controller 14 to LED light source 18 represents the current flowing to the LED circuit of LED light source 18 in order to power the LEDs for emitting light. (Ex. 1002, ¶105.) Thus, *Shackle* discloses controller 14 (*e.g.*, microcontroller (Ex. 1021, 1:64, 2:6)) operable to control a current flow to the at least one LED circuit discussed for limitation 1(c). (Ex. 1002, ¶105.) While *Shackle* does not explicitly disclose that controller 14 includes a *transistor* operable to control the current flow to the LED circuit, it would have been obvious in view of the state of the art to configure the modified *Shackle* lighting device to implement this feature. (Ex. 1002, ¶105.)

A POSITA would have been knowledgeable about transistors—basic building blocks of electronics that were used widely in various engineering contexts decades before the ’583 patent—and would have recognized that virtually all circuits of nontrivial complexity include transistors. (*Id.*, ¶106.) A POSITA would have known that transistors were useful for their ability to serve as a switch to control the flow of current in a circuit. (*Id.*; Ex. 1011, ¶[0042]; Ex. 1046, 4:43-48; Ex. 1049, FIG. 4, 3:13-16.) *Shackle*’s controller 14 may be implemented with various modules (*e.g.*, memory module 24 and control module 26 (FIG. 2)) adapted to control “overall operation of LED drive 10”) (Ex. 1021, 4:16-32) that operate consistent with microcontrollers by monitoring, analyzing, and generating control signals for the current signals output by drive 10 (*id.*, 3:56-4:12, 4:33-54, 5:24-6:3). The modules may be implemented using hardware, software or a combination thereof. (*Id.*, 6:4-14; Ex. 1002, ¶107.)

Thus, a POSITA would have been motivated to configure such modules with transistor(s), known to be used for such microcontroller-based hardware. (Ex. 1002, ¶108.) Indeed, given that transistors were well known for implementing switches that conditionally couple nodes in a circuit, a POSITA would have found a transistor to be useful and predictable for controlling the starting/stopping of the supply of current as *Shackle*'s controller 14 operates. (Ex. 1039, FIG. 2, ¶[0032] (disclosing a switch conditionally coupling nodes for switching between multiple possible voltages supplied to OLED); *see also* Ex. 1031, 112-117; Ex. 1040, FIG. 5 (FET 272), 10:54-11:13 (describing FET 272); Ex. 1002, ¶108.) A POSITA would have been capable of implementing a transistor with controller 14's modules to control the starting/stopping the supply of current to LED light source 18, especially since it would have involved the use of known technologies/techniques in a straightforward manner to predictably provide a controller 14 with known circuit components for facilitating the control of current supplied to light source 18. (Ex. 1002, ¶108.) As such, a POSITA would have had a reasonable expectation of success in implementing such a configuration. (*Id.*)

f) wherein the at least one LED circuit, the transistor, and the LED driver are all mounted on a reflective substrate.

While *Shackle* (as modified) does not disclose that the at least one LED circuit, the transistor, and LED drive 10 ("the LED driver") are all mounted on a reflective substrate, it would have been obvious in view of *Birrell* and *Schultz* to implement this feature. (Ex. 1002, ¶¶109-113.) First, a POSITA would have been motivated to mount the components of *Shackle*'s lighting device on a substrate to ensure the circuits/components had a supporting base, consistent with known/common circuit design practices. (Ex. 1002, ¶109.) Second, a POSITA would have likewise found it obvious to enhance the illumination properties of the lighting device by using reflective material on such a substrate, also consistent with known lighting designs and applications at the time. (*Id.*) Indeed, *Birrell* and *Schultz* provided such guidance to a POSITA at the time.

Birrell describes the known practice of providing a "printed circuit board subassembly 58 which provides the mechanical support for circuitry and the electrical components," including LEDs, sensors, power supply and data circuitry, and a microcontroller. (Ex. 1014, 15:15-16:10, FIG. 1.) *Birrell* also describes the desire for a device "optimized for uniform optical reflection to provide a uniform diffused light source." (*Id.*, 12:29-33.) Such features were consistent with the known use of a reflective substrate to provide mechanical support for an LED lighting device. (Ex. 1002, ¶110; Ex. 1018, 6:6:-12, 6:48-7:34 (LED array substrate with integral reflector component), FIGS. 18, 19, 27); Ex. 1012, Abstract (LED chips mounted on the circuit board and coated with "a layer of high reflection material on the board to collect light"), FIG. 2.1, ¶¶[0018], [0034], [0081].)

For example, *Schultz* discloses LED illumination systems (Ex. 1032, ¶¶[0002]-[0010]), and thus would have been considered by a POSITA when contemplating *Shackle*'s device/system. (Ex. 1002, ¶111.) *Schultz* teaches that with non-reflective circuit boards "[a]ny light from the LED die that strikes the circuit board is unutilized due to absorption or scattering of the light." (Ex. 1032, ¶[0048].)

Schultz discloses that by mounting the LED dies on a reflective circuit board, "the utilization of the light is improved." (*Id.*) Accordingly, a POSITA would have similarly been motivated by *Schultz*'s teachings to address the problem of unutilized light due to absorption or scattering by the substrate that would mount the components of *Shackle*'s lighting device. (Ex. 1002, ¶111.)

Thus, in light of the state of the art knowledge of a POSITA and the guidance provided by *Birrell* and *Schultz*, a POSITA would have been motivated, and found obvious, to configure *Shackle*'s lighting device to mount the LED circuit in light source 18 (limitation 1(c)), controller 14's modules including a transistor (limitation 1(e)), and LED driver (limitation 1(b)) on a reflective substrate in order to provide a base support for facilitating implementation of the device with enhanced lighting characteristics via reflective material on the substrate. (*Id.*) A POSITA would also have been so motivated given *Birrell*'s and *Shultz*'s guidance and the knowledge of a POSITA regarding increasing the optical efficiency of the lighting system. (Ex. 1002, ¶112; Ex. 1032, ¶[0047] ("Just as LED dies are being used in a number of different application, the use of light-managing flexible circuitry to package LED dies is also useful in a variety of applications"); Ex. 1018, 6:6-12; Ex. 1012, ¶[0018]; Ex. 1033, 16:24-45.) Such a modification would have been no more than the predictable use of known lighting design techniques (*e.g.*, adding a reflective layer to a substrate or forming the substrate from a reflective material) and components according to their established functions. (Ex. 1002, ¶112.) *KSR*, 550 U.S. at 417.

Given the knowledge of a POSITA and disclosures of *Birrell* and *Schultz* and the knowledge of a POSITA, a POSITA would have had a reasonable expectation of success in implementing such a modification—especially given it would have involved the use of known technologies/techniques to predictably produce an LED lighting device that benefited from known properties of reflective base structures, as suggested by *Birrell* and *Schultz*. (Ex. 1002, ¶113.)

2. Claim 3

a) The LED lighting device of claim 1, wherein the same substrate is a PCB substrate.

Shackle-Birrell-Schultz in view of the state of the art discloses/suggests this limitation.[6] (Ex. 1002, ¶¶114-115.) The analysis for limitation 1(f) explains how *Birrell* discloses a printed circuit board (PCB) 58 on which components including LEDs 59 are mounted (Ex. 1014, 15:15-21) and how in light of the collective disclosures of *Birrell-Schultz* it would have been obvious to configure *Shackle*'s lighting device to mount the components discussed for limitations 1(b)-1(e) on a reflective substrate. (§IX.A.1(f).) *Schultz* also discusses rigid circuit boards and the

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[6] Petitioner assumes "the same substrate" of claim 3 refers to the "substrate" of claim 1, and reserves the right to challenge this claim under §112 in other proceedings.

replacement use of flexible reflective substrates for similar purposes. (*Id.*; Ex. 1032, FIGS. 6-9, ¶[[0047]-[0048].) Moreover, printed circuit boards (PCBs) were well known to a POSITA and ubiquitous as a substrate on which various circuit components are mounted. (Ex. 1035, 1:60-2:5; Ex. 1002, ¶114.) Thus, in light of such disclosures in *Birrell-Schultz* and *Schultz* and the state of the art, a POSITA would have been motivated, and found it obvious, to configure the flexible substrate discussed for limitation 1(f) as a flexible printed circuit board (PCB) substrate. (Ex. 1002, ¶114.) Such a configuration would have been predictable, routine usage of existing technology (*e.g.*, PCBs and flexible substrates as discussed by *Birrell* and *Schultz*). (*Id.*) A POSITA would have been skilled at circuit design/implementation and adept at using printed circuit boards in various contexts, and implementing such materials as a flexible and reflective PCB for reasons similar to those discussed above for limitation 1(f). (*Id.*, ¶115.) Thus, for similar reasons, a POSITA would have had a reasonable expectation of success implementing such a modification, especially given it would have involved the use of known components/technologies and design techniques within the knowledge of a POSITA, and as suggested by the disclosures of *Birrell-Schultz*. (*Id.*) *KSR*, 550 U.S. at 416.

3. Claim 5

a) The LED lighting device of claim 1, wherein the plurality of LEDs includes at least one LED of a different color than another LED of the plurality of LEDs.

While *Shackle* does not explicitly disclose this limitation, it would have been obvious in view of *Birrell* and *Schultz* to configure the plurality of LEDs (discussed for limitation 1(c), §IX.A.1(c)) of the *Shackle*-*Birrell*-*Schultz* device to include at least one LED of a different color than another LED of the plurality of LEDs. (Ex. 1002, ¶¶116-117.) *Birrell* discloses the known use of different colored LEDs in a lighting system. (Ex. 1014, 11:26-34 (explaining a light source is an LED and in one form includes "at **least three light sources [that] are red, green and blue LEDs**"); 13:31-33; Ex. 1002, ¶116.) *Birrell*'s disclosures are consistent with that known in the art regarding the common use of different colored LEDs. (Ex. 1002, ¶116; *e.g.,* Ex. 1012, ¶¶[0033], [0090].)

In light of *Birrell* and the state of the art knowledge of a POSITA, a POSITA would have been motivated and found obvious to implement the *Shackle*-*Birrell*-*Schultz* lighting device to use different colored LEDs to increase the versatility of the types of lighting devices contemplated by *Shackle*. (Ex. 1002, ¶117.) Indeed, a POSITA would have appreciated that "[b]y controlling the amount of light emitted from each of these LEDs, most colours of light can be generated," as suggested by *Birrell*. (*Id.*; Ex. 1014, 11:26-34.) Thus, a POSITA would have found using LEDs of different colors to be convenient and useful for expanding the lighting applications of S*hackle*'s device, which is not limited to same colored LED applications (Ex. 1021, 6:15-24), and also a predictable application of conventional technology, as demonstrated by *Birrell*. (Ex. 1002, ¶117.) Given the use of different colored LEDs in lighting devices was known, the above configuration would have been a straight forward application of known technologies/techniques that a POSITA would have found predictable to implement with a reasonable expectation of success. (*Id.*) *KSR*, 550 U.S. at 416.

4. Claim 6

a) The LED lighting device of claim 1, wherein the same substrate is a reflective substrate.

Shackle-*Birrell*-*Schultz* discloses/suggests this limitation for the same reasons above for limitation 1(f).[7] (Ex. 1002, ¶118; §IX.A.1(f).)

[7] Petitioner makes the same assumption and reservation of rights discussed for claim 3. (§IX.A.2.)

B. Ground 2: Claim 7 is Obvious over *Shackle* in View of *Birrell*, *Schultz*, and *Smith*

1. Claim 7

a) The LED lighting device of claim 1, wherein the LED lighting device is dimmable when connected to a dimmer switch.

Shackle-*Birrell*-*Schultz* in view of *Smith* and the state of the art discloses/suggests this limitation. (Ex. 1002, ¶¶58-78, 119-124.) As discussed, *Shackle* discloses controlling a current, including increasing the current signal provided to LED light source 18 ("LED circuit"). (§IX.A.1(e); Ex. 1021, 1:56-61, 2:6-11, 2:65-3:6, 3:17-22, 3:35-62; Ex. 1002, ¶120.) While *Shackle* does not explicitly disclose that the lighting device is dimmable when connected to a dimmer switch, it would have been obvious in view of *Birrell* and *Smith*, and the state of the art to implement such features. (Ex. 1002, ¶120.)

The use of dimmer switches and dimming functionalities in LED lightings systems was known to a POSITA at the time. For example, *Birrell* explains that its lighting system may include "integrally embedded electronic manual controls such as touch **switches** or **light level controls**, **remote controls**…, automatic controls such as…**automatic light level controls**." (Ex. 1014, 8:4-30.) The microcontroller included in the lighting system may "**control the various light tile functions**" (*id.*, 15:34-36) and "typically **controls the total amount of energy available to all the LEDs** and is able to **control individual LED brightness**" (*id.*, 15:36-16:10.) A

POSITA would have understood that *Birrell* discloses that its lighting system is dimmable, because controlling LED brightness and controlling the light level includes decreasing (dimming) the brightness. (Ex. 1002, ¶121.)

Additionally, it was well known to a POSITA to implement a *switch* for achieving various functions, including dimming LED lighting by switching between various brightness levels. For example, *Smith* explains that "**[d]immer switches are well known** devices for saving electrical power to or varying the light intensity of an illuminating device" and that "[s]uch dimmer switches typically include a variable resistance which the user adjusts for varying the electrical power to the light source to alter the light source intensity," which a POSITA would have understood includes decreasing the light source intensity to achieve dimming. (Ex. 1019, 1:13-19; *id.*, Title, Abstract (disclosing a "dimmer switch assembly" and "control circuit" that can decrease the intensity of a light source), FIGS. 1-10, 3:23-51, 5:17-6:24.) *Smith*'s and *Birrell*'s disclosures of dimming switches and dimming functionalities are consistent with that known in the art regarding selective control of light output in LED lighting applications. (Ex. 1002, ¶122; Ex. 1020, Abstract, FIGS. 1-3, ¶¶[0029] ("dimmer switch 82"), [0037] ("The DC dimmer switch 82 may also be installed in a wall of the area to be illuminated, it may be incorporated into the DC light switch or it may be located within the bright white LED light fixture 20."); Ex.

1030, ¶¶[0114], [0116] (discussing dimming features for LED lighting device, including use of a "dimmer on a wall"), [0122]).)

In light of such disclosures in *Birrell* and *Smith*, and the state of the art, a POSITA would have been motivated and found it obvious to configure the *Shackle-Birrell-Schultz* lighting device to be dimmable when connected to a dimmer switch in wall or ceiling mounted applications, such as those described by *Birrell*. (Ex. 1002, ¶123.) A POSITA would have recognized that implementing known dimmer functionality through a dimming switch (*e.g.*, exemplified by *Smith*) would have predictably and beneficially enhanced the versatility of certain applications of the *Shackle-Birrell-Schultz* lighting device, *e.g.*, by enabling a user to adjust the lighting level of the device through conventional dimming switch features, like that described by *Smith*. Indeed, as explained above, *Birrell* describes the known use of adjusting the brightness of LEDs in LED lighting devices and *Smith* exemplifies known dimming switch features that a POSITA would have been well aware of at the time. (Ex. 1002, ¶123.) Thus, a POSITA would have recognized the advantages of implementing dimming functionalities with the *Shackle-Birrell-Schultz* lighting device and appreciated that implementing them using conventional dimming switch connections would have been a foreseeable way of providing such brightness control features in, for example, wall or ceiling mounted LED lighting device applications, like those suggested by *Birrell*. (*Id.*; Ex. 1014, 4:24-32, 10:33-36, 13:15-18, 17:4-

5.) Given that dimmer switches were well known in the art as explained above, and considering the skills and capabilities of a POSITA at the time, a POSITA would have found the above modification a straightforward implementation of known technologies/techniques (*e.g.*, use of dimmer switches in lighting application), which would have been configured with a reasonable expectation of success. (Ex. 1002, ¶124.) *KSR*, 550 U.S. at 416.

C. Ground 3: Claim 2 and 4 Are Obvious over *Shackle* in View of *Birrell*, *Schultz*, and *Salam*

1. Claim 2

a) The LED lighting device of claim 1, wherein the same substrate is a heat sink.

Shackle-Birrell-Schultz in view of *Salam* discloses or suggests this limitation.[8] (Ex. 1002, ¶¶58-75, 79-80, 125-130.) While *Shackle-Birrell-Schultz* does not explicitly disclose that the substrate discussed for claim 1 is a heat sink, it would have been obvious to implement such features in view of *Salam*. (Ex. 1002, ¶126.)

Salam "relate[s] to ... LED lamps" (Ex. 1015, 1:13-14), and thus a POSITA contemplating implementing *Shackle-Birrell-Schultz*'s LED lighting device would have had reason to consult *Salam* for guidance regarding LED-based lighting

[8] Petitioner makes the same assumption and reservation of rights discussed for claim 3. (§IX.A.3.)

applications. (§IX.A.1(a); Ex. 1015, Title, Abstract, 2:13-15; Ex. 1002, ¶127.) For example, Figure 13 of *Salam* (annotated below) shows a "**heat sink 86** [red] which may be of metal" (Ex. 1015, 13:1-3), and which "**serves as a final substrate** for **mounting** the device [light source 90 of Figure 13] **onto a heat sink**" (*id.*, 13:1-22). (*See also id.*, 17:3-5; Ex. 1002, ¶127.) *Salam* explains that the heat sink is near an active region of an LED. (Ex. 1015, 17:18-21 ("For each of the arrangements of FIGS. 11, 12, 13, 17e, 19e the LED active region (10, 110) is preferably less than 50 microns away from [] the heat sink….").)

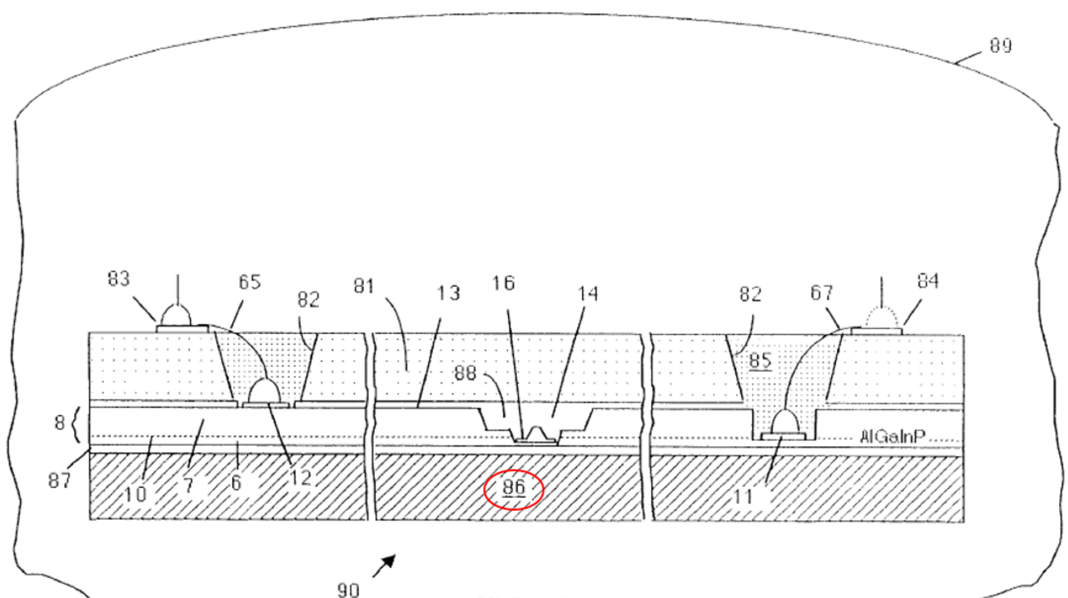
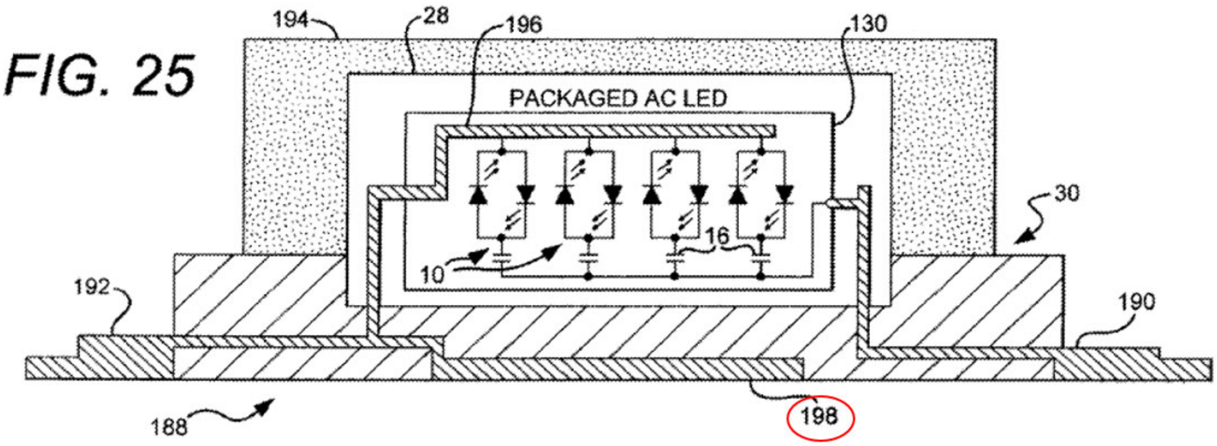


FIG. 13

(Ex. 1015 (*Salam*), FIG. 13 (annotated); Ex. 1002, ¶127.)

Thus, *Salam* discloses a heat sink that is a substrate, and further discloses mounting a lighting device onto the heat sink, consistent with the disclosure of the

'583 patent. (Ex. 1001, FIG. 25 (below; heat sinking material 198 annotated in red); *see also id.*, 17:31-38; Ex. 1002, ¶128.)



(Ex. 1001, FIG. 25 (annotated); Ex. 1002, ¶128.)

In light of *Salam*, a POSITA would have been motivated to configure the substrate of the *Shackle*-*Birrell*-*Schultz* LED lighting device to be a heat sink in order to dissipate heat produced during operation of the LED circuit. (Ex. 1002, ¶129.) A POSITA would have recognized that the LEDs of the combined *Shackle*-*Birrell*-*Schultz* LED lighting device generate heat and accordingly would have found it important to mitigate any damage caused by such heat to improve circuit reliability and/or performance of the device, as was known in the art. (*Id.*; *see also* Ex. 1026, 7:34-8:1; Ex. 1012, ¶[0092] (heat sink for a circuit board), FIG. 3.1.)

A POSITA would have been skilled at circuit design/implementation and capable of implementing the above configuration, which would have been a straightforward combination of known technologies/techniques (*e.g.*, known use of heat sink design, including substrate-based heat dissipation designs), to predictably produce an LED lighting device with substrate materials/designs that mitigated heat effects, given that it was known that a heat sink was practical and desirable for "draw[ing] heat from the active region of the chip." (Ex. 1015, 3:7-9; Ex. 1002, ¶130.) *KSR*, 550 U.S. at 416. For similar reasons, a POSITA have had a reasonable expectation of success implementing such a configuration. (Ex. 1002, ¶130.)

2. Claim 4

a) The LED lighting device of claim 3, wherein the PCB substrate is mounted to a heat sink.

Shackle-Birrell-Schultz-Salam discloses/suggests this limitation for reasons similar to those explained for claim 2 (§IX.C.1) and claim 3 (§IX.A.2).[9] (Ex. 1002, ¶¶131-132.) While *Shackle-Birrell-Schultz* does not explicitly disclose that PCB substrate is mounted to a heat sink, it would have been obvious in view of *Salam* to implement this feature. (*Id.*) As explained for claim 2, *Salam* discloses with reference to Figure 13 a "**heat sink 86** which may be of metal" (Ex. 1015, 13:1-3), and which "**serves as a final substrate** for **mounting** the device [light source 90 of Figure 13] **onto a heat sink**" (*id.*, 13:1-22). (*See also id.*, 17:3-5; Ex. 1002, ¶131.) Also explained for claim 2, it would have been obvious in view of the state of art

[9] Petitioner makes the same assumption and reservation of rights discussed for claim 3. (§IX.A.3.)

and *Salam* to modify the substrate used in the *Shackle-Birrell-Schultz* lighting device to be a heat sink. (§IX.C.1.) For similar reasons, a POSITA would have been motivated, and found obvious, to configure the PCB substrate used in the *Shackle-Birrell-Schultz* lighting device (as discussed for claim 3 (§IX.A.2)) to be mounted to a heat sink to likewise mitigate damaging effects caused by heat generated by operation of LED circuit and associated circuitry in the device. (Ex. 1002, ¶131; §IX.C.1 (regarding reasons for modifying the described substrate as a heat sink).)

A POSITA would have had similar motivation, skills and capabilities, and expectation of success as discussed above for claim 2 (regarding modifying the substrate as a heat sink) to configure the PCB substrate discussed for claim 3 such that it mounted to a heat sink because it would have predictably resulted in a substrate design that sought to dissipate heat generated by operation of the LED lighting device circuitry. (Ex. 1002, ¶131.) Indeed, a POSITA, who would have been skilled in circuit design for lighting applications like those contemplated by the *Shackle-Birrell-Schultz* lighting device, would have been guided by the suggestions of *Salam* and their knowledge regarding heat sink applications, to contemplate and implement a configuration where the PCB substrate mounting the device components (discussed for limitation 1(f)) was mounted to a heat sink (*e.g.*, a heat dissipating layer, a layer or further substrate designed to facilitate air flow, *etc.*) with a reasonable expectation of success in achieving such features (*Id.*, ¶132.)

D. Ground 4: Claims 11, 12, and 14 Are Obvious over *Shackle* in View of *Piepgras*

1. Claim 11

a) An LED lighting device comprising:

To the extent limiting, *Shackle* discloses or suggests an LED lighting device (*e.g.*, the components shown in *Shackle*'s Figure 1), for the reasons discussed above regarding the preamble of claim 1. (§IX.A.1(a); Ex. 1002, ¶¶58-65, 81-85, 133-134; §§IX.D.1(b)-(f).)

b) at least one LED circuit having a plurality of LED packages, wherein the plurality of LED packages emit light of a same color or of different colors;

Shackle discloses an LED light source 18 (shown in block diagram format in Figures 1-2, 4, which a POSITA would have understood necessarily includes at least one LED *circuit* for the reasons explained for limitation 1(c). (*See* §IX.A.1(c); Ex. 1002, ¶135-142.) While *Shackle* does not expressly disclose at least one LED circuit having a plurality of LED packages that emit light of a same or color or of different colors, it would have been obvious in view of *Piepgras* to implement these features in the *Shackle* device. (Ex. 1002, ¶¶135.)

Piepgras, like *Shackle*, relates to an LED lighting device. For example, *Piepgras* discloses "a lighting system or device 500" shown below in Figure 1. (Ex. 1030, ¶[0088].)

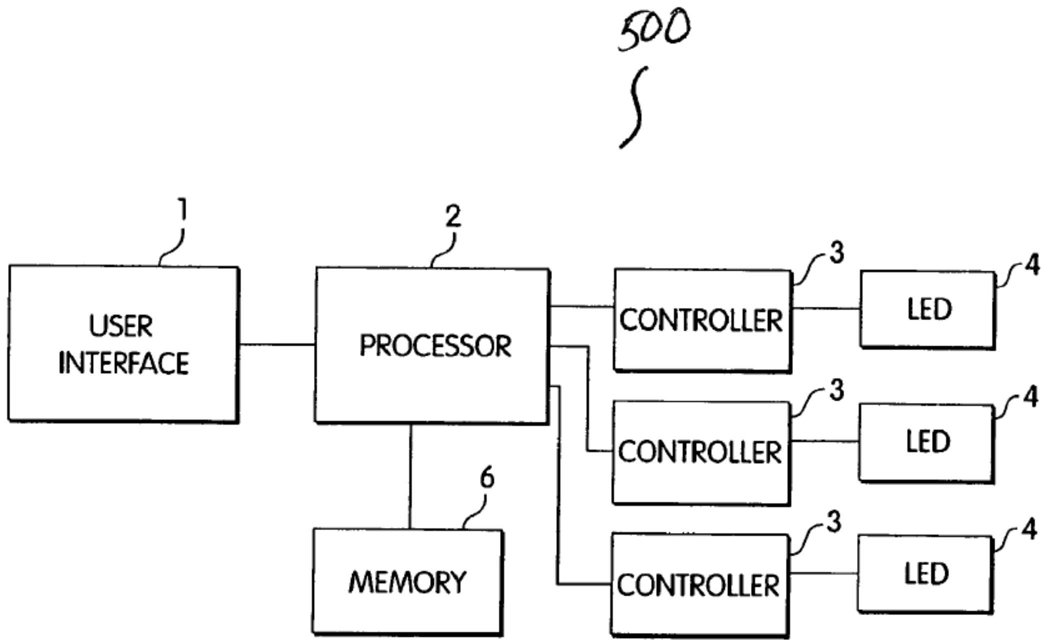


Fig. 1

(*Id.*, FIG. 1; *id.*, ¶¶[0033], [0088]-[0093] (describing Figure 1), [0094]-[0098], FIGS. 2A-2B, [0099]-[0105]; Ex. 1002, ¶136.)

Additionally, *Piepgras* discloses several examples of specific lighting devices implemented using system 500. (Ex. 1030, Title, Abstract, ¶¶[0083]), [0106]-[0241], FIGS. 3-54; Ex. 1002, ¶137.) System 500 (Figure 1) is a general arrangement implemented with the various lighting device examples described throughout *Piepgras*. (Ex. 1002, ¶137.)

Thus, a POSITA contemplating implementing *Shackle*'s LED lighting device would have had reason to consider the teachings of *Piepgras*, which describes various examples of implementing an LED lighting device. (Ex. 1002, ¶138.)

Having looked to *Piepgras*, a POSITA would have seen that *Piepgras* discloses LEDs 4 controlled by controllers 3 in the lighting device (*e.g.*, as shown above in Figure 1). (Ex. 1030, FIG. 1; Ex. 1002, ¶138.) A POSITA would have understood that *Piepgras* discloses LED circuits that include LEDs 4. (Ex. 1002, ¶138.) For example, a POSITA would have had this understanding because *Piepgras*' LEDs receive current (and voltage, and power), and a circuit is needed in order to achieve such electrical attributes. (Ex. 1030, ¶¶[0088] ("driving the LEDs 4, which may include controlling the current, amplitude, duration, or waveform of the signals impressed on the LEDs 4"), [0090] ("The controller 3 generally regulates the current, voltage and/or power through the LED…."); Ex. 1002, ¶138.)

Piepgras also discloses that the LEDs in the disclosed system can be packaged and include chips, as known in the art. For example, *Piepgras* explains that "an 'LED' may refer to a single [LED] package having [individually controlled] multiple semiconductor dies." (Ex. 1030, ¶¶[0085].) Further, *Piepgras* "does not restrict the package type of LED" such that an "'LED' includes packaged LEDs", "chip on board LEDs and LEDs of all other configurations" and that an "LED" "includes [] LEDs packaged…with phosphor…[to] convert energy from the LED to a different wavelength." (*Id.*; *see also id.*, ¶[0124] (describing that "[p]repackaged LEDs generally combine in a surface mount package or a T package" and that "surface mount LEDs," "chip on board technologies" and direct die substrate mounting technologies were known and could be employed), [0136] (describing for FIG. 19 that the LED 1900 "in this configuration, **or in other configurations described herein using reflective surfaces, may be in any package**"), [0160] (describing for FIG. 31 that "LED dies of different colors may be packaged together in each LED subsystem 3102" where each "die [is] individually controllable"); Ex. 1002, ¶139.)

Piepgras further discloses that its LED packages *emit light of a same color or of different colors*. (Ex. 1002, ¶140.) *Piepgras* describes that the LEDs in the disclosed LED packages in the various lighting device applications include "visible color LEDs" (Ex. 1030, ¶[0085]) and that "[t]he term 'color' should be understood to refer to any frequency of radiation, or combination of different frequencies, within the visible light spectrum" (*id.*, ¶[0086]). Thus, a POSITA would have understood that each LED can be any color. (Ex. 1002, ¶140.) For example, *Piepgras* discloses that "several LEDs 4 with different spectral output may be used" and "**[e]ach of these colors** may be driven through separate controllers 3" allowing for "color mixing" lighting effects. (Ex. 1030, ¶[0090]; *see id.*, ¶[0124] ("projecting different colors simultaneously" (*e.g.*, thus using different colored LEDs)), ¶[0085] (use of phosphor to convert LED energy wavelengths to produce different colors); Ex. 1002, ¶140.)

In light of *Piepgras*' disclosures, a POSITA would have been motivated, and found it obvious, to configure the *Shackle* device to include at least one LED circuit having LED packages that emit the same or different colors depending on the application. (Ex. 1002, ¶141.) For example, a POSITA would have found it useful and beneficial to configure *Shackle*'s device to include at least one LED circuit having LED packages that emit the same or different colors (*e.g.*, similar to that described by *Piepgras*), as that would have been a conventional way to implement the LED light source. (*Id.*) Indeed, a POSITA would have sought to leverage conventional, known technologies, *e.g.*, for efficiency and ease of design/implementation, and thus would have been motivated to consider the guidance provided by *Piepgras* to package LEDs in LED circuit(s) to facilitate design configurations based on the type of LED lighting device contemplated by *Shackle*. (*Id.*; Ex. 1021, 6:15-23.) Likewise, using LED packages that emit the same or different colors would have expanded the versatility of such applications, and thus a POSITA would have found it predictable, expected, and obvious to implement such features in the *Shackle* device. (Ex. 1002, ¶141.)

A POSITA would have been skilled at circuit design/implementation and thus would have been capable of implementing such a modification with a reasonable expectation of success, especially given the use of LED packages and same or different LED color combinations was well known in the art (as demonstrated by *Piepgras*). (*Id.*, ¶142.)

c) a glass substrate;

While *Shackle* does not explicitly disclose a glass substrate, it would have been obvious in view of *Piepgras* to implement this feature. (Ex. 1002, ¶¶143-146.) For example, *Piepgras* discloses applications where its "illumination devices 500…in connection with FIG. 1" are used in arrangements with an "optic" (*e.g.*, 4202, annotated in red below in Figure 42) that may be constructed of "**glass**" to "allow[] for the transmission or partial transmission of light." (Ex. 1030, ¶[0188]; *see also* §IX.D.1(a).) *Piepgras* further discloses a reflective material 4204 "designed to reflect at least a portion of the light transmitted through the optic 4202," and that material 4204 "may be…co-extruded in the optic 4202, embedded in the optic 4202…or otherwise arranged such that light may be reflected by the material 4204 through the optic." (*Id.*, ¶[0189]; *see also id.*, ¶[0190] (lighting device 4200 including "LED based illumination devices 500" where one processor 2 controls both devices 500 or each device 500 has its own processor 2 to project light to be reflected by material 4204); Ex. 1002, ¶143.)

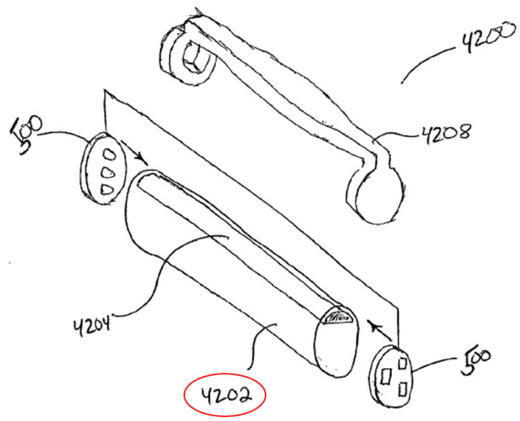


Figure 42

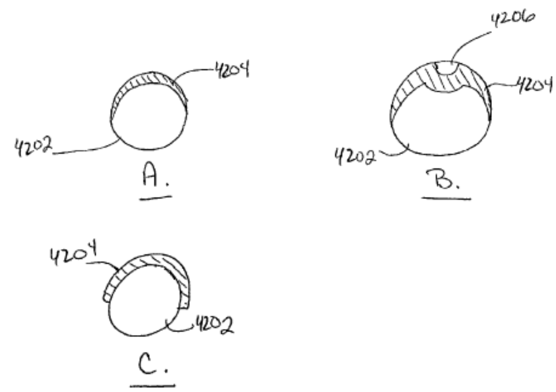


Figure 43

(Ex. 1030, FIG. 42 (annotated), FIG. 43; Ex. 1002, ¶143.)

Piepgras discloses that device(s) 500 "may be epoxied or otherwise attached to **the various types of optics** to minimize the loss of light" and thus describes that the optics (integrated with the reflective material) mounting the devices 500 would be a reflective base that can be attached supporting, among other things, the LEDs of system 500). (Ex. 1030, ¶[0197]; Ex. 1002, ¶144.) *Piepgras* also discloses "a platform where the LED-based illumination devices are mounted may be made of or coated with a reflective material," and "the platform may be constructed of materials designed to increase the reflection off of the platform[']s surface (*e.g.* a white platform, a platform coated with a reflective material)." (Ex. 1030, ¶[0197].)

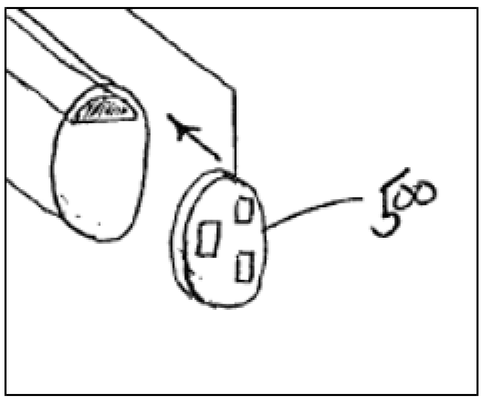
Thus, where *Piepgras*' system 500 is attached to an optic integrated with reflective material (as described in connection with Figures 42-48 (Ex. 1030,

¶¶[0190]-[0197], such an optic is a *glass substrate* that supports the system 500. (Ex. 1002, ¶145.)

In light of *Piepgras*' disclosures, a POSITA would have been motivated, and found it obvious, to implement a glass substrate in the modified *Shackle* device. (*Id.*, ¶146.) For example, a POSITA would have found it useful to implement a substrate in order to mount other components of the lighting device (as explained below for limitation 11(d), §IX.D.1(d)), and would have found it beneficial to use a *glass* substrate in order to permit transmission of light (emitted by LEDs of LED packages discussed for limitation 11(b)) through it and thus promote enhanced illumination. (Ex. 1002, ¶146.) This would have been a combination of known components and technologies, according to known methods, to produce predictable results. (*Id.*) *KSR*, 550 U.S. at 416.

d) a flexible substrate mounted to the glass substrate, wherein at least one of the plurality of LED packages is mounted to the flexible substrate;

While *Shackle* does not explicitly disclose the features of limitation 11(d), it would have been obvious in view of *Piepgras* to implement such features in the *Shackle-Piepgras* device discussed for limitation 11(c). (Ex. 1002, ¶¶147-151.) *Piepgras* discloses various configurations and applications of lighting system 500, including those including the reflective platform from which system 500 can be mounted. (Ex. 1030, ¶[0197]; §IX.D.1(c).) Given that the "platform" is described with reference to illumination devices 500 generally (*e.g.*, lighting system 500 of Figure 1), a POSITA would have understood that *Piepgras*' disclosure regarding the reflective platform is applicable to all of its configurations, especially where such reflective properties would provide efficient lighting for the relevant application. (Ex. 1002, ¶147.)



(Ex. 1030, FIG. 42 (excerpted).)

One of the applications relates to a rope light as described with reference to Figure 31 (below). As explained, a "rope light 3100 [] include[s] a plurality of LEDs or LED subsystems 3102 according to the description provided in reference to FIGS. 1 and 2A-2B." (Ex. 1030, ¶[0160].)

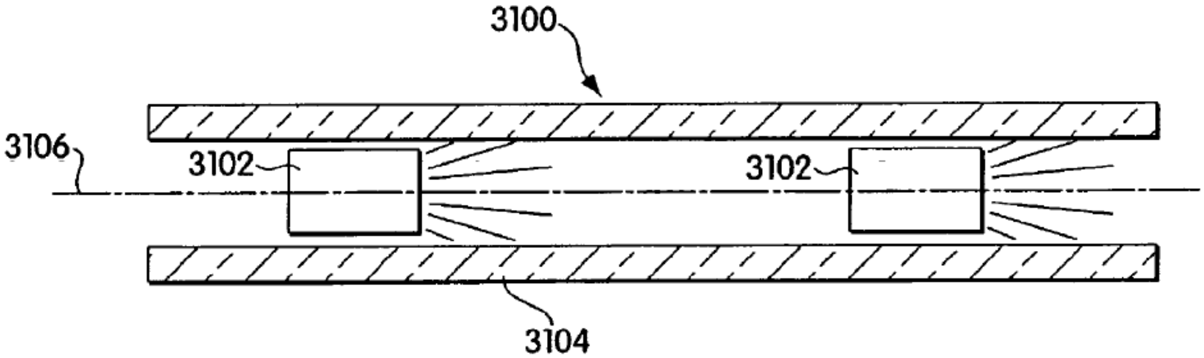


Fig. 31

(Ex. 1030, FIG. 31.) *Piepgras* discloses that "[a] plurality of these LED subsystems 3102 may be disposed inside of a tube [3104] that is **flexible** and transparent." (*Id.*, ¶[0160].) A POSITA would have understood that because the LED subsystems 3102 (according to the descriptions of Figures 1, 2A-2B) are within the flexible tube 3104, the platform on which the LED subsystems 3102 are mounted would likewise need to be flexible to accommodate the flexible characteristics (and applications) of a rope light. (Ex. 1002, ¶148.) Indeed, without such properties, the rope light would need to be rigid where subsystems 3102 were located, which can be, *e.g.*, "every six inches." (Ex. 1030, ¶[0160].) Such rigidity across a length of rope lighting, which can be "several feet or more" (*id.*), would detract from the flexible application of such a lighting device, and would lend the device to be prone to failure by bending of the platform (substrate) that mounts subsystems 3102. (Ex. 1002, ¶148.) In one example, the walls of tube 3104 can be the "platform" that mounts subsystems 3102, or at least would necessarily provide a base for a "platform" mounting subsystems 3102, consistent with that shown in FIG. 31. Thus, a POSITA would have understood that in such a flexible application, *Piepgras* discloses the use of a flexible substrate, which is necessarily present for mounting the components of lighting system 500 encompassed in subsystems 3102. (*Id.*)

As noted above, *Piepgras* provides for configurations where a reflective platform (reflective substrate) mounts lighting system 500 in a manner applicable generally to the inventions of *Piepgras* (Ex. 1030, ¶[0197]), and thus including the rope lighting application discussed above. Thus, a POSITA would have understood that *Piepgras* discloses and contemplates configurations where tube 3104 is a flexible substrate, and where a tubing wall may also include reflective material that acts as the "platform" for mounting the subsystems 3102, such that the light emitted from the LEDs is directed in a particular direction from the rope light. (Ex. 1002, ¶149.)

In light of *Piepgras*' disclosures, a POSITA would have found it predictable to configure the *Shackle-Piepgras* device to implement a flexible substrate mounted to the glass substrate, wherein at least one of the plurality of LED packages is mounted to the flexible substrate. (*Id.*, ¶150.) A POSITA would have found mounting a flexible substrate to the glass substrate to be useful, *e.g.*, for promoting versatility, efficiency, and performance characteristics of the lighting device.

Indeed, flexible printed circuit boards were known in the art as being desirable. (Ex. 1017, ¶¶[0032] ("[A]power supply unit is preferably mounted on a **flexible printed circuit board**, and the flexible printed circuit board is bent into a generally S-shaped form. ... This arrangement makes it possible to save space, to ensure high insulating performance, and also to improve the characteristics and reliability of the device."); Ex. 1002, ¶150.)

A POSITA would have been capable of implementing such mounting; indeed, the '583 patent does not describe any technical challenges or unexpected results associated with such mounting. (*See generally* Ex. 1001; Ex. 1002, ¶151.) A POSITA would have been motivated to mount at least one of the plurality of LED packages to the flexible substrate, in order to secure the packages spatially. (Ex. 1002, ¶151.) A POSITA would have been skilled at circuit design and would have found the various "mount[ing]"-related features of limitation 11(d) to be straightforward to implement with a reasonable expectation of success, as the above configuration would have been a combination of known components and technologies, according to known methods, to produce predictable results (*e.g.*, mounting various known components to other known components). (*Id.*) *KSR*, 550 U.S. at 416.

e) an LED driver having an input for receiving a first AC voltage and a first frequency, the LED driver providing a second AC voltage or a second DC voltage output to the plurality of LED packages;

Shackle-Piepgras discloses or suggests this limitation. (Ex. 1002, ¶¶152-153.) For instance, as discussed for limitation 1(b), *Shackle* discloses LED drive 10 ("an LED driver") having an input (red below) for receiving a first AC voltage (*e.g.*, 120 V AC) and a first frequency (*e.g.*, 60 Hz), the LED driver providing a DC voltage ("a second AC voltage or a second DC voltage") output to LED light source 18. (§IX.A.1(b); Ex. 1021, FIGS. 1-2, 2:2-5; Ex. 1002, ¶152.)

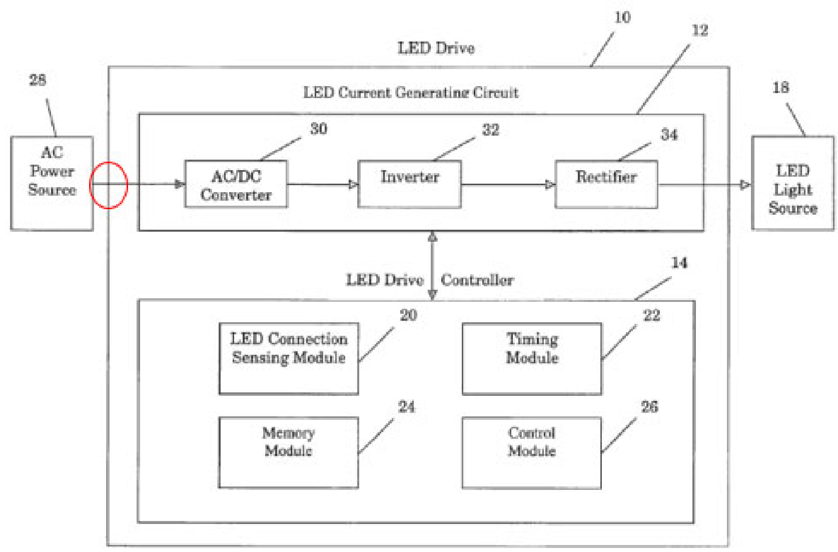


Fig. 2

(Ex. 1021, FIG. 2 (annotated); Ex. 1002, ¶152.)

While *Shackle* does not explicitly disclose drive 10 ("the LED driver") providing its DC voltage output to *the plurality of LED packages* discussed for limitation 11(b), it would have been obvious in view of *Piepgras* to implement this feature. (Ex. 1002, ¶153.) For example, in light of *Piepgras*' disclosure of packaged LEDs (and LED packages), a POSITA would have understood that the LED packages require voltage and current (and thus power) in order for the LED light source to emit light. (*Id.*, ¶153.) Indeed, given that *Shackle* discloses providing DC voltage to an LED light source, a POSITA would have found it predictable and obvious to provide the DC voltage to LED packages that have LEDs. (*Id.*) A POSITA would have been skilled at circuit design/implementation and would have found the above implementation to be feasible and straightforward, and accordingly would have had a reasonable expectation of success implementing it. (*Id.*)

f) wherein the LED driver comprises a high frequency stage, the high frequency stage providing an inverter and an output frequency higher than an AC mains input frequency to the LED driver.

Shackle (as modified above) discloses this limitation for the reasons discussed for limitation 1(d), which is identical to limitation 11(f). (§IX.A.1(d); Ex. 1002, ¶154.)

2. Claim 12

a) The LED lighting device of claim 11, wherein the flexible substrate is a reflective substrate.

Shackle-Piepgras discloses or suggests this limitation. (Ex. 1002, ¶¶155-158.) As discussed for limitation 11(c), *Piepgras* discloses a reflective platform on which LED devices are mounted (§IX.D.1(c); Ex. 1030, ¶[0197]), and as discussed for limitation 11(d), *Piepgras* discloses a rope light with reference to Figure 31 (§IX.D.1(d); Ex. 1030, FIG. 31, ¶[0160]). Given that *Piepgras* provides for configurations where a reflective platform (reflective substrate) mounts lighting system 500 in a manner applicable generally to the inventions of *Piepgras* (Ex. 1030, ¶[0197]), and thus including the rope lighting application discussed above, a POSITA would have understood that *Piepgras* discloses and contemplates configurations where tube 3104 is a flexible substrate, and a tubing wall may also include reflective material that acts as the "platform" for mounting the subsystems 3102 such that the light emitted from the LEDs is directed in a particular direction from the rope light. (Ex. 1002, ¶155.)

In light of *Piepgras*, a POSITA would have found it obvious to configure the *Shackle*-*Piepgras* device so that the flexible substrate discussed for limitation 11(d) is a reflective substrate, *e.g.*, so that light can be effectively directed in a desired direction, to enhance illumination. (Ex. 1002, ¶156.) A POSITA would have been motivated to implement such a configuration given the above disclosures and guidance discussed above (relating to the rope light application and reflective platform configurations), and given that *Piepgras* was aware of the benefits of using curved reflective components for focusing light projected from the LEDs. (Ex. 1002, ¶156; Ex. 1030, ¶¶[0132] (curved surface to reflect light in FIG. 33), [0136] (curved/planar reflective surfaces for reflecting light for FIGS 19-21 applications), [0192] (curved shape reflector for optics embodiments in FIGS. 43A-43C), [0215] (reflective and curved reflective surface for FIG. 50 application).) Such disclosed features were consistent with the knowledge in the art regarding the use of reflective and flexible substrates for LED lighting applications. (Ex. 1002, ¶156; Ex. 1018, FIGS. 8-9, 27, 2:20-21, 5:8-30, 6:6-7:34.)

Given the knowledge in the art, and the above-noted disclosures/suggestions by *Piepgras*, a POSITA would have been motivated to configure the LED lighting system (claim 1) to provide a flexible reflective substrate. A POSITA would have appreciated that such a modification would have expanded the applications and types of devices that could be provided, *e.g.*, similar to *Piepgras*' flexible rope light with reflective substrate material to direct light from one side of the walls through the transparent walls on another side or curved lighting systems with reflective substrate that reflects light from the LEDs, *e.g.*, curved wall plate or decorative applications (such as curved wall/ceiling decorative lighting devices, etc.). (Ex. 1002, ¶157.)

Thus, a POSITA would have had the motivation, capability and knowledge to implement such a configuration with a reasonable expectation of success, especially given the state of the art knowledge of a POSITA in context of the disclosures of *Piepgras* as noted above. (*Id.*, ¶158.) Consequently, the modification would have involved the application of known technologies and techniques that would have predictably led to usage of a flexible and reflective substrate to provide versatile applications with controlled light direction, consistent with *Shackle*'s LED lighting device. (*Id.*)

3. Claim 14

a) The LED lighting device of claim 11, wherein the LED lighting device includes a three way switch that is selectable by a user.

Shackle-Piepgras discloses this limitation. (Ex. 1002, ¶¶159-161.) For instance, *Shackle* discloses that different LED sources "known in the art" and the LED drive is adapted to be used with different "types of LED light sources." (Ex. 1021, 6:15-23.) Thus, a POSITA would have been motivated to implement the modified *Shackle* device (discussed for claim 11) in various applications, including environments that use light switches to control power to the lighting device. (Ex. 1002, ¶159.) A POSITA would have been so motivated given such applications were well known at the time, as demonstrated by *Piepgras*. (*See* discussions of *Piepgras* in §§IX.D.1; Ex. 1002, ¶159.)

Among such disclosures/suggestions, *Piepgras* describes an implementation where device 500 includes a three way switch that is selectable by a user. (Ex. 1030, ¶[0115] ("**Three-way** light bulbs are also a **common** device for changing illumination levels. These systems use two contacts on the base of the light bulb and the light bulb is installed into a special electrical socket with two contacts. By turning a **switch** on the socket, either contact on the base may be connected with a voltage or both may be connected to the voltage. The lamp includes two filaments of different resistance to provide **three levels of illumination**."); Ex. 1002, ¶160.) A POSITA would have understood that *Piepgras*' disclosure of "turning a switch" regarding the three-way switch refers to a user selecting a switch position. (Ex. 1030, ¶[0115]; Ex. 1002, ¶160.) Moreover, a POSITA would have known and been familiar with three-way switch implementations in lighting systems to provide selective illumination control, like that contemplated by *Piepgras*. (Ex. 1036, Abstract, ¶[0018]; Ex. 1029, 1:11-18; Ex. 1028, 3:66-4:10, 5:12-32; FIG. 4; Ex. 1002, ¶160.)

In light of such knowledge of a POSITA and *Piepgras*' disclosures, a POSITA would have been motivated, and found it obvious, to configure the *Shackle-Piepgras* device to include a three way switch that is selectable by a user. (Ex. 1002, ¶161.) A POSITA would have recognized that usage of such a "common" technology (*see supra*; Ex. 1030, ¶[0115]) would have provided the user with a convenient way to control lighting. (Ex. 1002, ¶161.) A POSITA would have been skilled at circuit design/implementation and would have found such a configuration to be simple, given that three-way switches were known. Indeed, the '583 patent does not associate any criticality with respect to the use of a three-way switch. (*See* generally Ex. 1001.) A POSITA would had a reasonable expectation of success implementing the above configuration, which would have been a combination of known components and technologies, according to known design techniques, to produce predictable results like those discussed above. (Ex. 1002, ¶161.) *KSR*, 550 U.S. at 416.

X. THE CIRCUMSTANCES WEIGH AGAINST DISCRETIONARY DENIAL

A. The *Fintiv* factors favor institution

An evaluation of the factors under *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (Mar. 20, 2020) (precedential), favors institution notwithstanding the concurrent Illinois Litigation (§II).

First factor. Petitioner intends to seek a stay of the Illinois Litigation upon institution. The Board has explained it will not speculate as to the outcome of such unresolved issues before a district court, *Google LLC et al. v. Parus Holdings, Inc.*, IPR2020-00847, Paper 9 at 12-13, and this factor is neutral where no such stay motion has yet been filed, *Hulu LLC v. SITO Mobile R&D IP, LLC*, IPR2021-00298, Paper 11 at 10-11 (May 19, 2021). Accordingly, this factor does not weigh in favor of discretionary denial.

Second factor. Regarding the Illinois Litigation, the court has not set a trial date.[10] (Exs. 1075, 1076, 1086-1087.) There has not been significant resource

[10] PO motion to transfer the Illinois-Litigation to Texas was denied. (Ex. 1085.)

investment by the court and the parties, particularly compared to the resource expenditures leading up to a trial. Moreover, any trial (if it occurs) would likely only occur at least 102 weeks after the service of the complaint (and indeed the complaint has been amended twice)—and thus after a final written decision in this IPR. (Ex. 1079, 1-2 (document available at Northern District of Illinois website, estimating "Case Ready for Trial" 102 weeks after complaint served); Ex. 1076, 8 (Dkt. #16 showing summons returned May 19, 2021).)

Third factor. The minimal investment by the court and parties in the Illinois Litigation weighs against discretional denial. Discovery is at an early stage. Expert discovery is not open, no depositions have occurred, and no substantive efforts toward claim construction have begun. In short, little has happened and the most resource intensive period in the district court case will occur after the institution decision in this proceeding. (*See* Exs. 1076, 1086.) This alone weighs against denial. *See*, *e.g.*, *Hulu*, IPR2021-00298, Paper 11 at 13.

Fourth factor. In the Illinois Litigation, PO has asserted only claims 8-10 and 16–17 of the '583 patent, while this Petition challenges claims 1-7 and 11, 12, and 14, so the Illinois Litigation will not resolve the validity issues disputed here. (§IX; Ex. 1083, 2-5; Ex. 1084, 2-11.) Furthermore, to mitigate any potential concerns, Petitioner stipulates that it will not pursue invalidity of the '251 patent in district court based on any instituted IPR grounds in this proceeding.

Fifth factor. That Petitioner is a party to the Illinois Litigation does not outweigh the other factors that strongly weigh against discretionary denial.

Sixth factor. Petitioner diligently filed this Petition with strong grounds (*supra* §IX) **within three months** of PO's assertion of the '583 patent (Ex. 1082, pp. 53-56, 67), **within two months** of PO's amended infringement contentions in the Illinois Litigation (Ex. 1083), and **more than nine months before** the statutory deadline for filing an IPR (Ex. 1082, 67). Such diligence weighs against exercising discretion. *See*, *e.g.*, *Hulu*, IPR2021-00298, Paper 11 at 13; *Facebook, Inc. v. USC IP P'ship, L.P.*, IPR2021-00033, Paper 13 at 13.

Further, the '583 patent issued on first office action without any substantive prior art analysis of the ultimately issued claims. (Ex. 1004, 178, 198, 199.) Institution is thus consistent with the significant public interest against "leaving bad patents enforceable." *Thryv, Inc. v. Click-To-Call Techs., LP*, 140 S. Ct. 1367, 1374 (2020). Moreover, this Petition is the ***sole*** challenge to claims 1-7 and 11, 12, and 14 to the '583 patent before the Board—a "crucial fact" favoring institution. *Google LLC v. Uniloc 2017 LLC*, IPR2020-00115, Paper 10 at 6 (PTAB May 12, 2020).

Accordingly, based on a "holistic view of whether efficiency and integrity of the system are best served," the facts here weigh against exercising discretion denial. *Samsung Elecs. Co. Ltd. v. Dynamics Inc.*, IPR2020-00505, Paper 11 at 15 (Aug. 12, 2020). At a minimum, factors 2, 3, 4, and 6 (or combinations thereof) outweigh factors 1 (neutral) and 5, and thus favor institution.

B. The Board Should Not Exercise Discretion Under § 325(d) To Deny the Petition

Discretionary denial under § 325(d) is inappropriate in view of the Petition's reliance on *Shackle*. Though cited in an IDS during prosecution, the Office erred in a manner material to the patentability of the challenged claims by not applying the teachings of *Shackle*. *Advanced Bionics, LLC v. Med-El Elekromediznische Geräete GMBH*, IPR2019-01469, Paper 6 at 8 (precedential). *Shackle* was not substantively discussed or distinguished during prosecution of the '583 patent. (*See generally* Ex. 1004; *id.*, 103.) Nor did the Examiner consider *Birrell*, *Schultz*, and *Piepgras* (not cited during prosecution) in light of *Shackle*'s material disclosures. (*See* §§X.A-X.D.) Further, the Examiner did not have the benefit of expert testimony explaining the significance of the combinations as explained above.[11] (*Id.*) Such oversight was critical and warrants consideration of *Shackle* in the above-asserted grounds during trial here. *Advanced Bionics* at 8-9.

Accordingly, institution of the Petition should not be denied because of the reliance on *Shackle*.

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[11] No prior art was applied before allowing the claims on first action. (Ex. 1004, 133-139, 185-186, 197-200.)

XI. CONCLUSION

Accordingly, Petitioner requests institution of IPR for the challenged claims based on the specified grounds.

Respectfully submitted,

Dated: October 28, 2021 By: /Joseph E. Palys/
Joseph E. Palys (Reg. No. 46,508)
Counsel for Petitioner

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 10,750,583 contains, as measured by the word-processing system used to prepare this paper, 11,125 words. This word count does not include the items excluded by 37 C.F.R. § 42.24 as not counting towards the word limit.

Respectfully submitted,

Dated: October 28, 2021

By: /Joseph E. Palys/
Joseph E. Palys (Reg. No. 46,508)
Counsel for Petitioner

CERTIFICATE OF SERVICE

I hereby certify that on October 28, 2021, I caused a true and correct copy of the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 10,750,583 and supporting exhibits to be served via express mail on the Patent Owner at the following correspondence address of record as listed on PAIR:

K&L Gates LLP-Chicago
P.O. Box 1135
Chicago IL 60690

By: /Joseph E. Palys/
Joseph E. Palys (Reg. No. 46,508)