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. 10,517,149

# PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,517,149

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# I. INTRODUCTION

Samsung Electronics Co., Ltd. ("Petitioner" or "Samsung") requests *inter partes* review of claims 1-20 ("challenged claims") of U.S. Patent No. 10,517,149 ("the '149 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

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

**<u>Related Matter</u>**: The '149 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 '149 patent and also U.S. Patent Nos. 10,492,252, 10,499,466, 10,966,298, 11,019,697, 10,506,674, 10,506,400, 10,492,251, 10,750,583, 10,154,551, and 10,652,979) ("Illinois-Litigation").
- *Lynk Labs, Inc. v. Samsung Electronics Co. Ltd. et al.*, 6:21-cv-00526 (W.D. Tex.), transferred to Illinois as Case No. 1:21-cv-05126 and consolidated with 1:21-cv-02665 (Illinois-Litigation)
- *Lynk Labs, Inc. v. The Home Depot USA, Inc.*, No. 6-21-cv-00097 (W.D. Tex.) (alleging infringement as to the '149 patent and also U.S. Patent Nos.

10,492,251, 10,757,783, 10,091,842, 10,932,341, 10,537,001, 10,349,479, 10,652,979, and 10,154,551) (W.D. Tex.) ("HD-Litigation")

- *The Home Depot USA, Inc. et al. v. Lynk Labs, Inc.*, IPR2022-00023 ("HD-IPR").

The '149 patent claims the benefit of priority to, *inter alia*, two provisional applications (U.S. Provisional Application Nos. 60/574,653, 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. 10,154,551 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01575 (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).

**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.

## 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 ’149 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 1-20 should be canceled as unpatentable based on the following grounds:

**Ground 1**: Claims 1 and 2 are unpatentable under pre-AIA 35 U.S.C. § 103(a) as being obvious over *Zhang* (Ex. 1005) and *Salam* (Ex. 1006);

**Ground 2**: Claim 3 is unpatentable under §103(a) as being obvious over *Zhang*, *Salam*, and *Mosebrook* (Ex. 1007);

**Ground 3**: Claim 4 is unpatentable under §103(a) as being obvious over *Zhang*, *Salam*, and *Michael* (Ex. 1008);

**Ground 4**: Claims 5-9 are unpatentable under §103(a) as being obvious over *Zhang* and *Piepgras* (Ex. 1009);

**Ground 5**: Claim 10 is unpatentable under §103(a) as being obvious over *Zhang*, *Piepgras*, and *Muthu* (Ex. 1025);

**Ground 6**: Claims 11-16 are unpatentable under §103(a) as being obvious over *Zhang* and *Michael*;

**Ground 7**: Claims 17-19 are unpatentable under §103(a) as being obvious over *Panagotacos* (Ex. 1026), *Zhang*, and *Muthu*; and

**<u>Ground 8</u>**: Claim 20 is unpatentable under §103(a) as being obvious over *Panagotacos*, *Zhang*, *Muthu*, and *Michael*.

The '149 patent issued from Application No. 16/215,502 filed December 10, 2018, and claims priority via a chain of applications to a provisional application filed February 25, 2004, which, for purposes of this proceeding and without concession, Petitioner assumes is the critical date.

*Zhang* (Ex. 1005) published on February 21, 2002. *Mosebrook* (Ex. 1007) published on November 9, 1999. *Michael* (Ex. 1008) published on April 7, 1987. *Muthu* (Ex. 1025) published on January 28, 2003. *Panagotacos* (Ex. 1026) published on March 21, 2002. These references therefore qualify as prior art under pre-AIA 35 U.S.C. § 102(b).

*Salam* (Ex. 1006) published on October 14, 2003 from an application filed March 30, 2001. *Piepgras* (Ex. 1009) published on July 24, 2003 from an application filed September 17, 2002. These references therefore qualify as prior art at least under pre-AIA 35 U.S.C. §102(a) and §102(e).

None of these references were considered during prosecution. (*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 '149 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.)[1] More education can supplement practical experience and vice versa. (*Id.*)

## VII. OVERVIEW OF THE '149 PATENT

The '149 patent purports its alleged invention relates to LEDs and drivers, *e.g.*, AC-driven LEDs/circuits. (Ex. 1001, 2:12-14, 3:55-10:40.) Yet, the challenged claims are broadly directed to an LED lighting system including conventional/well-known generic components arranged to operate according to their known functions. The '149 patent was allowed on first action during prosecution (Ex. 1004, 316-322) and the Examiner's statement of reasons for allowance did not identify any purportedly allowable limitation of independent claims 5 and 11 (*compare* Ex. 1004, 321, *with* Ex. 1001, 23:33-42, 24:4-12). Regarding independent claims 1 and 17, the features listed by the Examiner, like all of the other generically claimed features, were already known in the prior art. *See In re 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.

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[1] Petitioner submits the declaration of R. Jacob Baker, Ph.D., P.E. (Ex. 1002), an expert in the field of the '149 patent. (Ex. 1002, ¶¶1-19; Ex. 1003.)

1002, ¶¶51-54, 92-205; *see also id.*, ¶¶22-50 (citing, *inter alia*, Exs. 1054, 1076, 1077, 1081, 1083-1087, 1089-1092, 1094, 1100, 1101), 56-91; *see generally* Ex. 1004; Exs. 1035-1053.)

## 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, no special constructions are necessary to assess whether the challenged claims are unpatentable over the asserted prior art as the asserted grounds demonstrate unpatentability under any reasonable interpretation of the claimed terms.[2] (Ex. 1002, ¶55.)

[2] 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 (Nov. 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[3]

## A. Ground 1: Claims 1 and 2 Are Obvious over *Zhang* and *Salam*

### 1. Claim 1

#### a) A lighting system comprising:

*Zhang* discloses a lighting system.[4] (Ex. 1002, ¶¶56-63, 92-110.) For instance, *Zhang* discloses a chip-on-board LED lighting system used for various lighting contexts, such as an illuminated exit sign, described with reference to Figure 2.1 (below) and constituting a "lighting system" as claimed. (Ex. 1005, Title ("Lighting Devices Using LEDS"), Abstract, (describing "5 lighting devices" such as "chip-on-board LED exit signs"), ¶¶[0022], [0032]-[0039], [0079] ("Chip-on-

[3] §IX references exhibits, other than the asserted prior art for each ground, to reflect the state of the art consistent with the testimony of Dr. Baker.

[4] In the Illinois-Litigation, Lynk asserts various products, including, *e.g.*, a refrigerator, washing machine, and dryer each constitute a "lighting system." (Ex. 1066, 2-5; Ex. 1067, 2, 7, 12, 18, 22, 28, 34, 44.) Though not at issue here, because the asserted prior art meets any reasonable definition of "lighting system," Petitioner reserves the right to dispute PO's interpretation of the preamble in the Illinois-Litigation as applied to accused products that are, on their face, not "lighting system[s]."

board LED Exit Signs"), [0089] ("Chip-on-board Back Lights"); *see also id.*, ¶¶[0002] ("LED exit signs"), [0005]-[0006] ("LED Exit Signs"), FIG. 2.1 (circuit diagram that a POSITA would have understood is applicable to *Zhang*'s systems, such as the exit sign system), ¶[0090]; Ex. 1002, ¶93; §IX.A.1(b)-(f).)

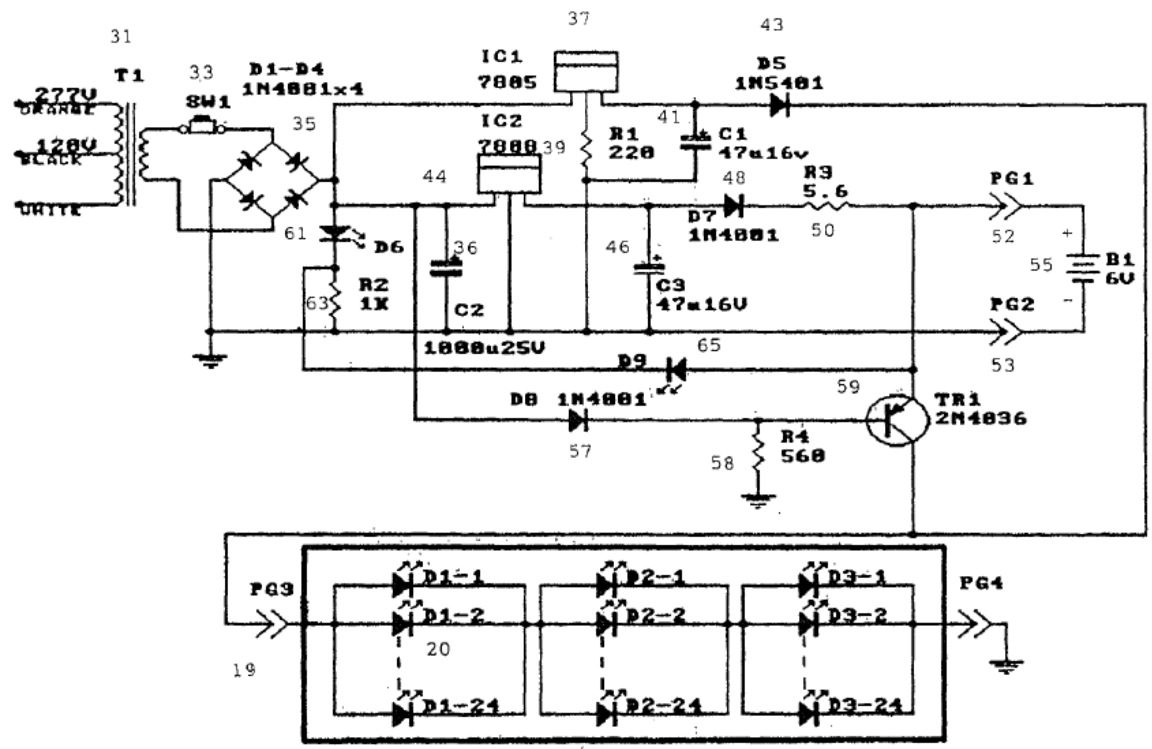



FIG. 4 <EXIT> SIGN
CIRCUIT DIAGRAM

Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1005, FIG. 2.1.)

**b) at least one LED circuit having a plurality of LEDs, wherein the plurality of LEDs includes same or different colored LEDs;**

*Zhang* discloses this limitation. (Ex. 1002, ¶¶94-96.) For instance, *Zhang* discloses, *e.g.*, with reference to Figure 2.1, that its lighting system(s) includes at least one LED circuit (red below) having a plurality of LEDs 20:

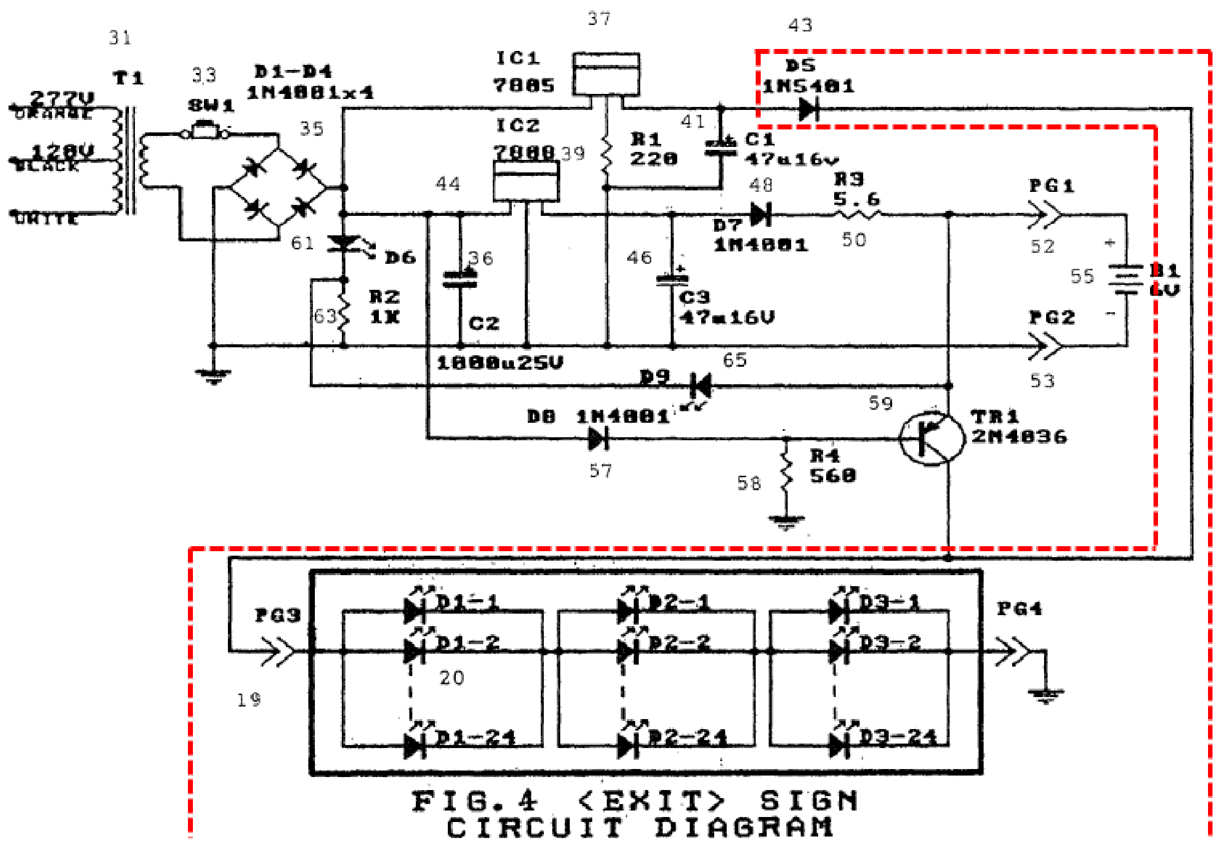



Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1005, FIG. 2.1 (annotated); *see also id.*, ¶¶[0080]-[0081] ("LED chips"), [0082]-[0087], [0088] ("The COBLEDES 19 has n LEDs i[n] one row and m [r]ows in parallel."), [0089]-[0090] ("LED lights"); Ex. 1002, ¶94.)

*Zhang* discloses that the plurality of LEDs includes "same or different colored LEDs," as claimed. (Ex. 1005, ¶[0033]; Ex. 1002, ¶95.) Indeed, "same or different colored" spans the entire range of possibilities for colors of LEDs, and no other options are possible, so a POSITA would have understood that *Zhang*'s disclosure meets this aspect of limitation 1(b). (Ex. 1002, ¶95.) Moreover, *Zhang* describes that its lighting system has "LED lights with red, yellow, orange, green, blue and white colors" and thus discloses different colored LEDs. (Ex. 1005, ¶[0090]; Ex. 1002, ¶96.)

**c) a driver, wherein the driver includes at least one transistor and at least one capacitor; and**

*Zhang* discloses this limitation. (Ex. 1002, ¶97.) For instance, as shown below in Figure 2.1, *Zhang* discloses a driver (red below), wherein the driver includes a transistor 59 ("at least one transistor") (green below) and capacitors C1, C2, C3 ("at least one capacitor") (orange below). (*Id.*) A POSITA would have understood that the portion of Figure 2.1 annotated in red below is a *driver*, *e.g.*, because that portion of the depicted circuit drives voltage and current to LEDs 20. (*Id.*; Ex. 1005, FIG. 2.1.) Indeed, the red-annotated portion below serves as a power supply that regulates the power required for LEDs 20. (Ex. 1002, ¶97.)

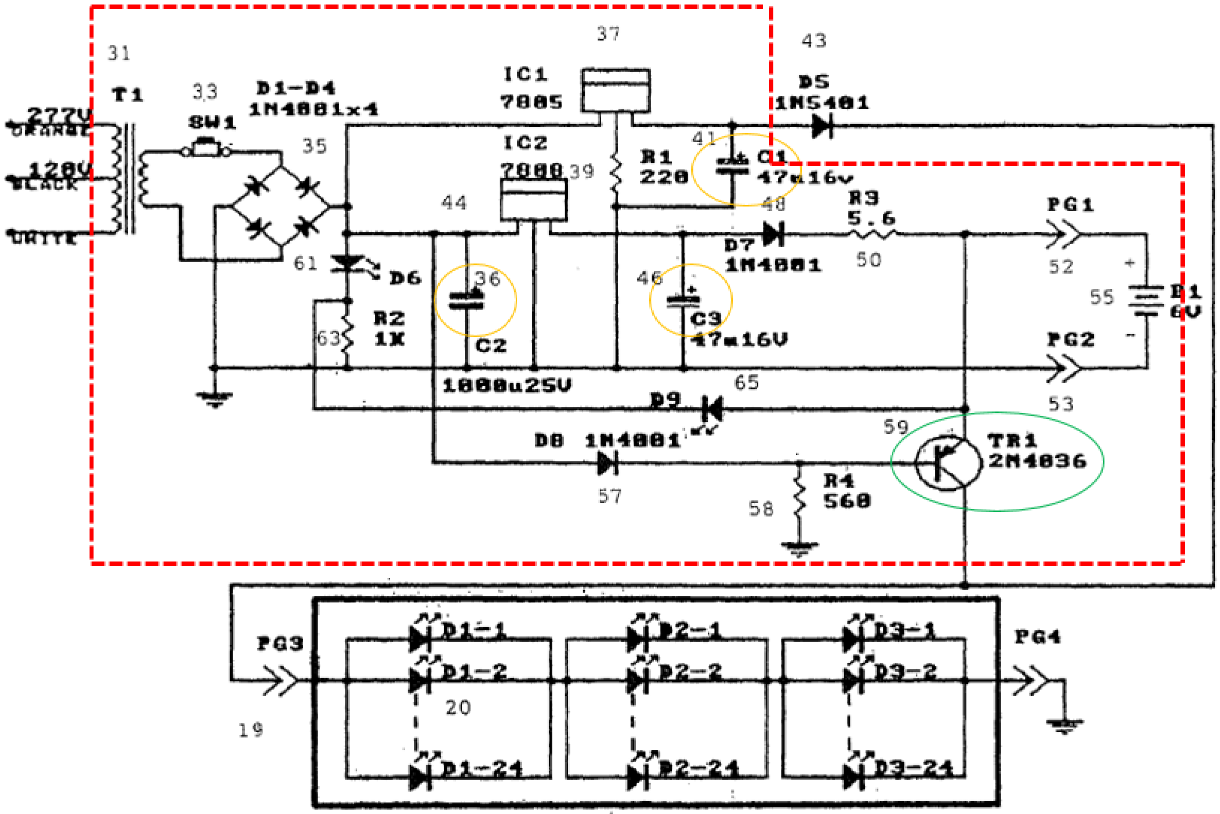



Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1005, FIG. 2.1 (annotated); Ex. 1002, ¶97; *see also* §IX.A.1(f) (explaining that *Zhang*'s driver (red above) is configured in the manner required by limitation 1(f)).)

**d) a package, wherein the package is a heat sinking reflective material;**

*Zhang* in combination with *Salam* discloses or suggests this limitation. (Ex. 1002, ¶¶64-65, 98-106.) For instance, *Zhang* discloses its lighting system includes a circuit board, which a POSITA would have understood to be a "package," consistent with the '149 patent. (Ex. 1005, ¶¶[0079] ("Chip-on-board LED Exit Signs"), [0083] ("The circuit board design is shown in FIG. 2.1."), FIG. 2.1

("Electronic Circuit Board for LED Exit Sign"); *infra* §IX.A.1(e) (claiming the driver and LED circuit are "mounted **on the package**"); Ex. 1002, ¶¶98-99.)

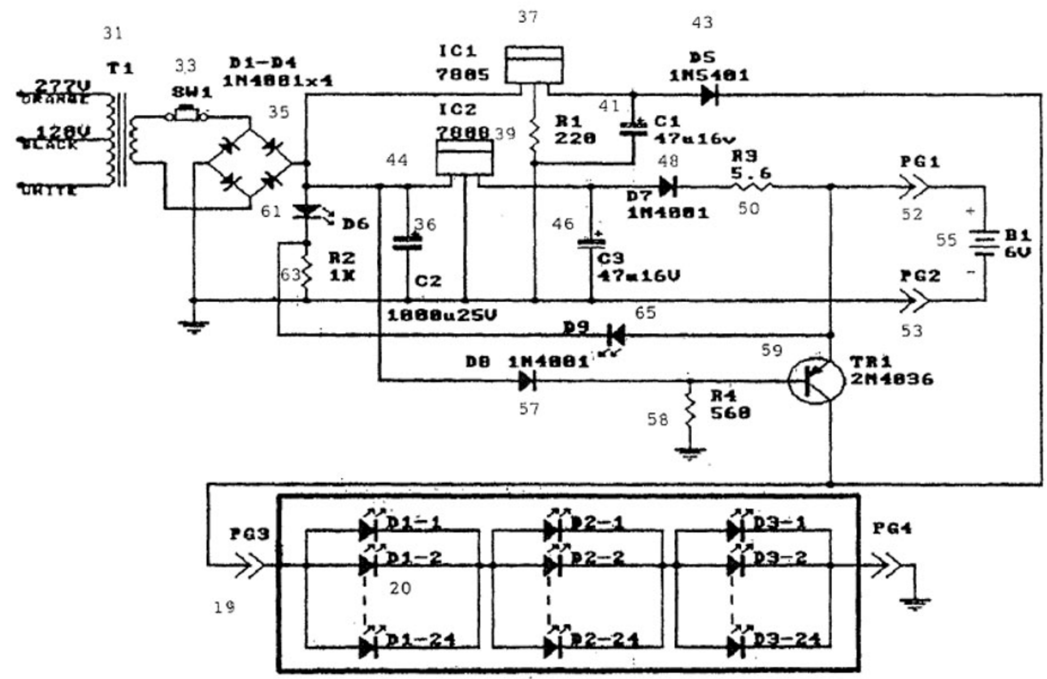



Fig. 2.1, Electronic Circuit Board for LED Exit Sign

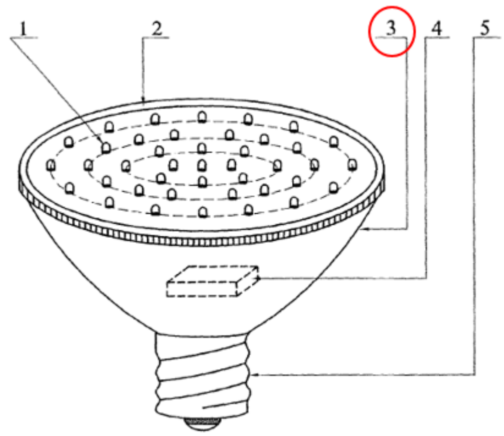
(Ex. 1005, FIG. 2.1 (annotated); Ex. 1002, ¶98.)

*Zhang* discloses that its circuit board ("package") is a reflective material. (Ex. 1005, ¶[0081] ("coat a layer of high **reflection material** on the top of the board"); *see also id.*, ¶¶[0018], [0034], Abstract; Ex. 1002, ¶99.)[5]

Additionally, *Zhang* discloses an LED lamp that includes an "aluminum coated plastic bowl 3 to be used as the **heat sink** for a circuit board," thus

[5] Emphasis added unless indicated otherwise.

recognizing the desire to remove heat from the circuit board. (Ex. 1005, ¶[0092], FIG. 3.1.)




| | | |
|---|---|---|
| 5 | Head | |
| 4 | Circui board | For power supply |
| 3 | Plastic wall | Coated by aluminum |
| 2 | Plastic cover | |
| 1 | LEDs | Can be any color |
| No | Part | Notice |

**Fig.3.1, LED Lamps**

(*Id.*, FIG. 3.1 (annotated); Ex. 1002, ¶100.)

Although *Zhang* does not explicitly disclose that the circuit board ("package") of its lighting system shown in Figure 2.1 is a heat sinking material (*e.g.*, does not explicitly state that the heat sink for a circuit board as in Figure 3.1 is applicable to the circuit board of Figure 2.1), it would have been obvious in view of *Zhang* and *Salam* to implement this feature. (Ex. 1002, ¶¶101-106.) *Salam* "relate[s] to ... LED lamps," (Ex. 1006, 1:13-14), and *Zhang* similarly discloses "lighting devices using [LEDs]," (Ex. 1005, ¶[0002]). (Ex. 1002, ¶¶56-65, 102; *see also* Ex. 1006, Title, Abstract, 2:13-15; Ex. 1005, Title.) Therefore, a POSITA would have had reason to consult the teachings of *Salam* for guidance regarding details of LED-based lighting systems when implementing *Zhang*'s lighting system (*e.g.*, LED exit sign). (Ex. 1002, ¶102.)

Figure 13 of *Salam* (annotated below) shows a "**heat sink 86** [red below] which may be of metal," (Ex. 1006, 13:1-3), and which "serves as a final substrate for mounting the device [of Figure 13] onto a heat sink," (*id.*, 13:19-22). (*See also id.*, 17:3-5; Ex. 1002, ¶103.) *Salam* explains that the heat sink is near an active region of an LED. (Ex. 1006, 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….").)

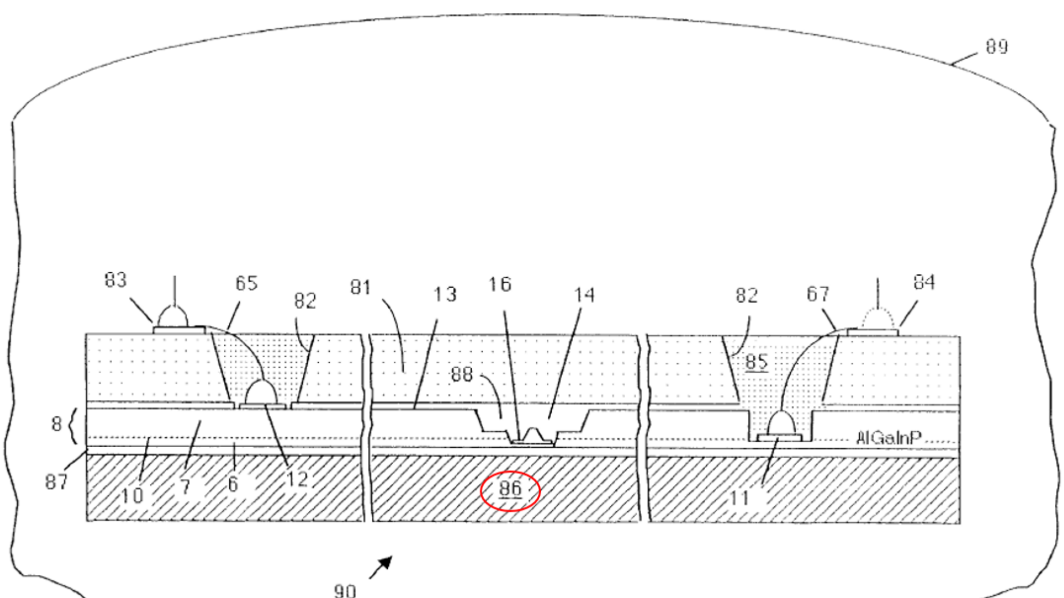
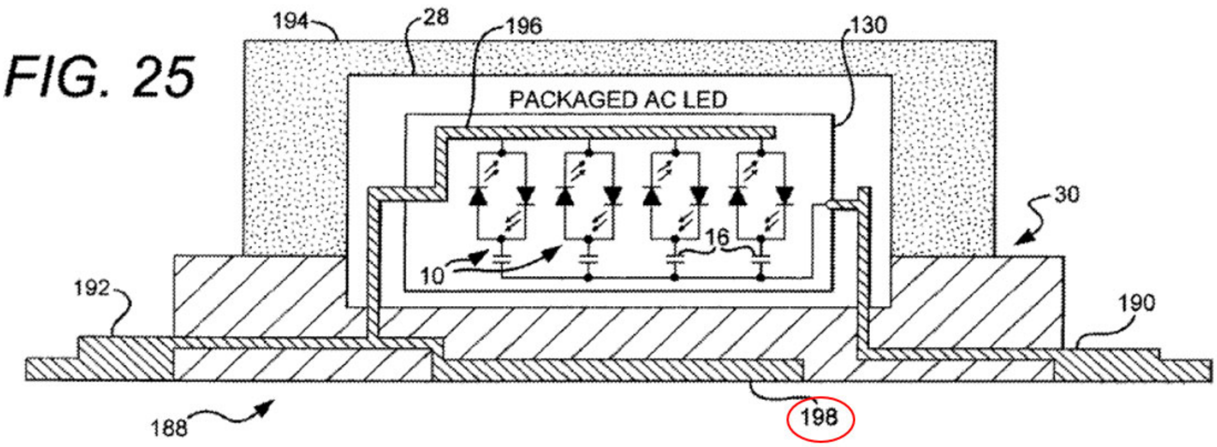


FIG. 13

(Ex. 1006 (*Salam*), FIG. 13 (annotated); Ex. 1002, ¶103.)

Thus, *Salam* discloses a package that is a heat sinking material, consistent with the disclosure of the '149 patent. (Ex. 1001, FIG. 25 (below) (heat sinking material 198 annotated in red); *see also id.*, 17:31-38; Ex. 1002, ¶104.)

FIG. 25




(Ex. 1001 ('149 patent), FIG. 25; Ex. 1002, ¶104.)

In light of *Zhang* and *Salam*, a POSITA would have been motivated to implement the "package" with (or as) a heat sinking material. (Ex. 1002, ¶105.) A POSITA would have recognized that *Zhang*'s LED lighting system generates heat and accordingly would have found it important to address such heat, *e.g.*, to improve circuit reliability and/or performance. (*Id.*; Ex. 1026, 7:34-8:1.)[6] Indeed, *Zhang*'s LED lamp of Figure 3.1 includes a heat sink as discussed, confirming that a POSITA implementing *Zhang*'s LED lighting system of Figure 2.1 would have found a heat

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[6] In Ground 1, Exhibit 1026 is cited to demonstrate the state of the art. (Ex. 1002, ¶105.)

sink to be relevant and desirable. (*Id.*; *see also* Ex. 1005, FIG. 4.1 (describing aluminum wall of lamp "[a]s heat sink"), ¶[0101]).) Given that *Salam* discloses a heat sink (*e.g.*, formed as a metal layer) upon which an LED is mounted, and *Zhang*'s contemplation of heat sink material, a POSITA would have been motivated to implement the package in *Zhang*'s lighting system with/as heat sinking reflective material to dissipate heat. (*Id.*)

A POSITA would have been skilled at circuit design/implementation and capable of achieving the above implementation, which would have been a straightforward combination of known components and technologies, according to known methods, to produce the predictable result of reducing/mitigating heat effects in a circuit, 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. 1006, 3:7-9; Ex. 1002, ¶106.) *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007). For similar reasons, a POSITA would have had a reasonable expectation of success implementing such a configuration. (Ex. 1002, ¶106.)

**e) the driver and the at least one LED circuit all mounted on the package; and**

*Zhang* (as modified) discloses this limitation. (Ex. 1002, ¶¶107-108.) As shown in Figure 2.1, *Zhang*'s circuit board ("package") includes the driver (red below) and LED circuit (green below):

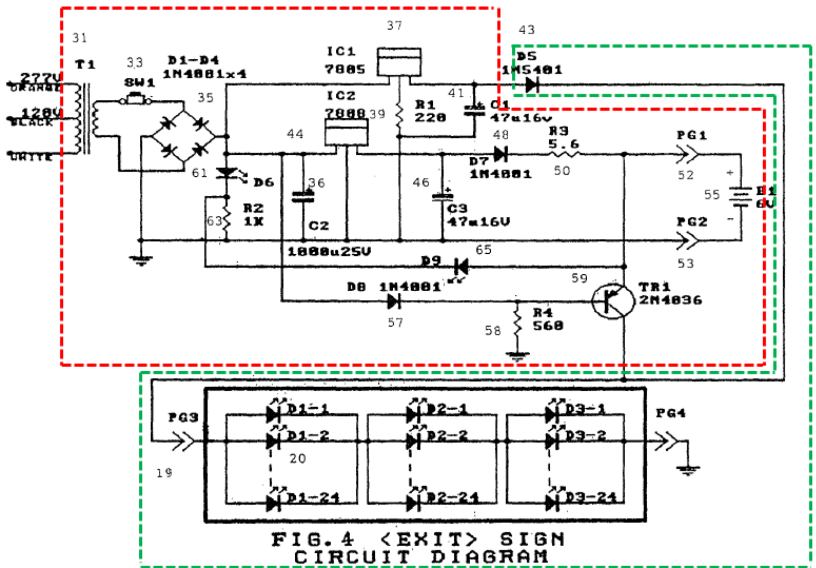


Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1005, FIG. 2.1 (annotated); *see also id.*, ¶[0083] ("The circuit board design is shown in FIG. 2.1."); Ex. 1002, ¶107.)

A POSITA would have understood that the circuit components shown in Figure 2.1 (which shows a circuit diagram for the circuit board) are *mounted* on the circuit board (Ex. 1002, ¶108) consistent with the well-known use of a circuit board for mounting various circuit components to achieve a circuit. (*Id.*; Ex. 1055, 1:60-2:5.)[7]

[7] Exhibit 1055 demonstrates the state of the art. (Ex. 1002, ¶108.)

**f) the driver is configured to receive an AC voltage from a mains power source and provide a voltage and current to the at least one LED circuit.**

*Zhang* (as modified above) discloses or suggests this limitation. (Ex. 1002, ¶¶109-110.) For instance, *Zhang* discloses that "circuit design allows the LED board to use 120 VAC or 220 VAC line power" (*i.e.*, "receive an AC voltage from a mains power source"). (Ex. 1005, ¶[0036]; *see also id.*, ¶[0083] ("The 120 VAC or 220 VAC power from the commercial line is reduced to 9 VAC by the transformer 31…."); Ex. 1002, ¶109.) As annotated below in red, the AC voltage is received at the driver, and a POSITA would have understood that voltage and current are provided to the LED circuit at the node annotated below in green, because LEDs require current to emit light and *Zhang* explains that "the output of the regulator lights the COBLEDES [chip-on-board LED exit sign] 19 through diode 43." (Ex. 1005, ¶[0084]; Ex. 1002, ¶¶38-49, 109.)

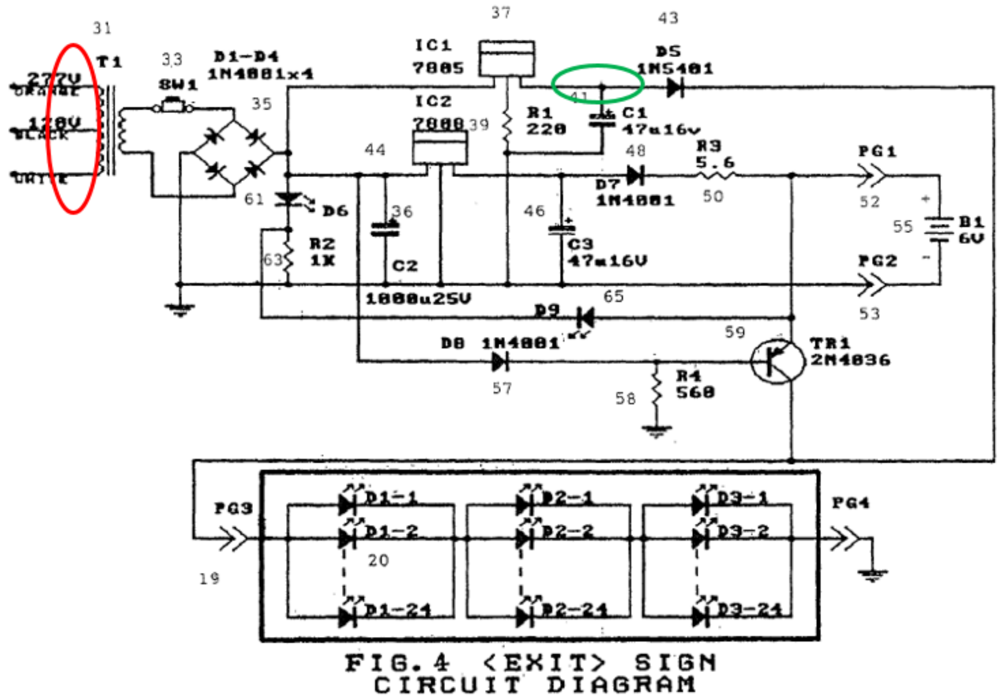


Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1005, FIG. 2.1 (annotated); Ex. 1002, ¶109.)

A POSITA would have understood that the AC voltage received via the commercial line is received from a *mains* power source. (Ex. 1012, 1:8-23; Ex. 1058, 1:25-29 ("a.c. mains (120 v.a.c., 60 Hz)"); Ex. 1002, ¶110.)[8]

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[8] Exhibits 1012 and 1058 demonstrate state of the art. (Ex. 1002, ¶110.)

**2. Claim 2**

**a) The lighting system of claim 1, wherein the driver is configured to receive at least two different AC forward voltages.**

*Zhang* (as modified above) discloses this limitation. (Ex. 1002, ¶¶111-112.) *Zhang* discloses that "circuit design allows the LED board to use **120 VAC or 220 VAC** line power" ("receive at least two different AC forward voltages"). (Ex. 1005, ¶[0036]; *see also id*., ¶[0083]; Ex. 1002, ¶111.) *Zhang* explains that "[t]he 120 VAC or 220 VAC power from the commercial line is reduced to 9 VAC by the transformer 31" shown in Figure 2.1. (Ex. 1005, ¶[0036].) *Zhang* thus discloses that the driver is configured to receive at least two different AC forward voltages via a bridge rectifier (red) as shown in *Zhang*'s Figure 2.1. (Ex. 1002, ¶111.)

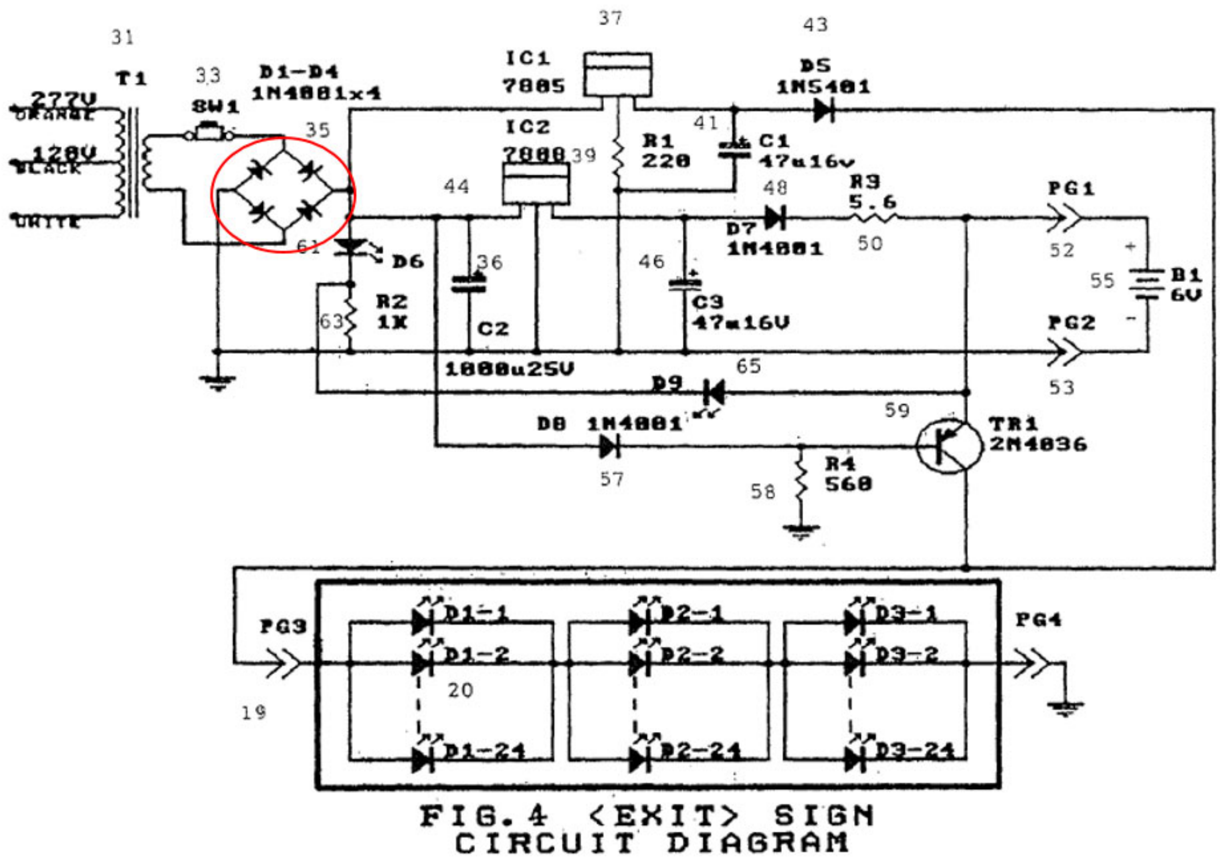


Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1005, FIG. 2.1 (annotated); Ex. 1002, ¶111.)

For example, it was understood that a positive voltage corresponds to a current flowing in a forward direction, which enables a diode (*e.g.*, LED) to turn on, and that *Zhang*'s bridge rectifier 35 (red circle) produces positive (forward) voltages where negative voltages were previously present, resulting in positive voltages at both half-cycles of an AC voltage sinusoid (which would otherwise have half its cycle positive and the other half negative. (Ex. 1015, ¶[0002]; Ex. 1019, ¶[0068], FIG. 2; Ex. 1002, ¶112.)[9]

### B. Ground 2: Claim 3 Is Obvious over *Zhang*, *Salam*, and *Mosebrook*

#### 1. Claim 3

##### a) The lighting system of claim 1, further comprising a three-way switch controlled by a user, wherein at least two of the plurality of LEDs are different colored LEDs.

*Zhang* in view of *Salam* and *Mosebrook* discloses or suggests this limitation. (Ex. 1002, ¶¶66-68, 113-118.) *Zhang* discloses that its lighting system includes "LED lights with red, yellow, orange, green, blue and white colors" ("at least two of the plurality of LEDs are different colored LEDs"). (Ex. 1005, ¶[0090].) *Zhang* also discloses the use of a switch in LED lighting devices that control signals connected to LEDs. (*Id.*, ¶[0119], FIG. 5.3.) While the *Zhang*-*Salam* combination does not explicitly disclose a three-way switch, it would have been obvious in view of *Mosebrook* and the state of the art to implement the claimed feature in the *Zhang-Salam* system to provide a lighting system that uses known switch technologies to control lighting. (Ex. 1002, ¶¶116-119.) *Mosebrook* describes lighting control systems, and thus would have been a relevant resource for a POSITA to consider

[9] Exhibits 1015 and 1019 demonstrate the state of the art. (Ex. 1002, ¶112.)

when implementing *Zhang*'s lighting system. (Ex. 1007, 1:12-15, 1:40-41; Ex. 1002, ¶¶66-68, 116.)

*Mosebrook* explains that it was known that "a user can install a so called **three-way electrical switch**, *i.e.*, an additional light control switch to an existing hardwired single control system," and a POSITA would have known that a three-way switch was a conventional device that was widely used in lighting systems, *e.g.*, to enable a user to control a lighting system from two places (*e.g.*, control a hallway light using switches at both ends of a hallway), or control the selection of functionality in lighting systems. (Ex. 1007, 2:30-35; *see also* Ex. 1016, 2:1-15, 3:66-4:5, FIGS. 1, 4; Ex. 1017, 5:27-32, FIG. 1 (showing three-way switches 22 and 23); Ex. 1056, ¶[0018]; Ex. 1002, ¶117.)[10]

In light of *Mosebrook* and state of the art knowledge, a POSITA would have been motivated and found obvious to modify the *Zhang-Salam* system to operate in an application that implements a user-controlled three-way switch. (Ex. 1002, ¶118.) A POSITA would have found it beneficial, *e.g.*, to provide increased flexibility to a user for controlling *Zhang*'s lighting system. (*Id.*) A POSITA would have been motivated to consider designs enabling lighting system control, *e.g.*, configuring the lighting system to work in conjunction with known three-way switch

[10] Exhibits 1016, 1017, and 1056 demonstrate state of the art. (Ex. 1002, ¶117.)

configurations that would use a three-way switch with the lighting system that operates with another switch at a different location, to provide similar functionality (*e.g.*, allow a user to turn on/off lighting features in the system from different locations). (*Id.*) Such an implementation would have been a mere combination of known components and technologies, according to known methods, to produce predictable results. (*Id.*) *KSR*, 550 U.S. at 416. A POSITA would have been skilled at circuit design and would have found a three-way switch to be simple to implement in various electrical systems, including *Zhang*'s lighting system. (Ex. 1002, ¶118.) Therefore, such a skilled person would have had a reasonable expectation of success regarding such an implementation in the combined *Zhang-Salam-Mosebrook* system. (*Id.*)

### C. Ground 3: Claim 4 Is Obvious over *Zhang*, *Salam*, and *Michael*

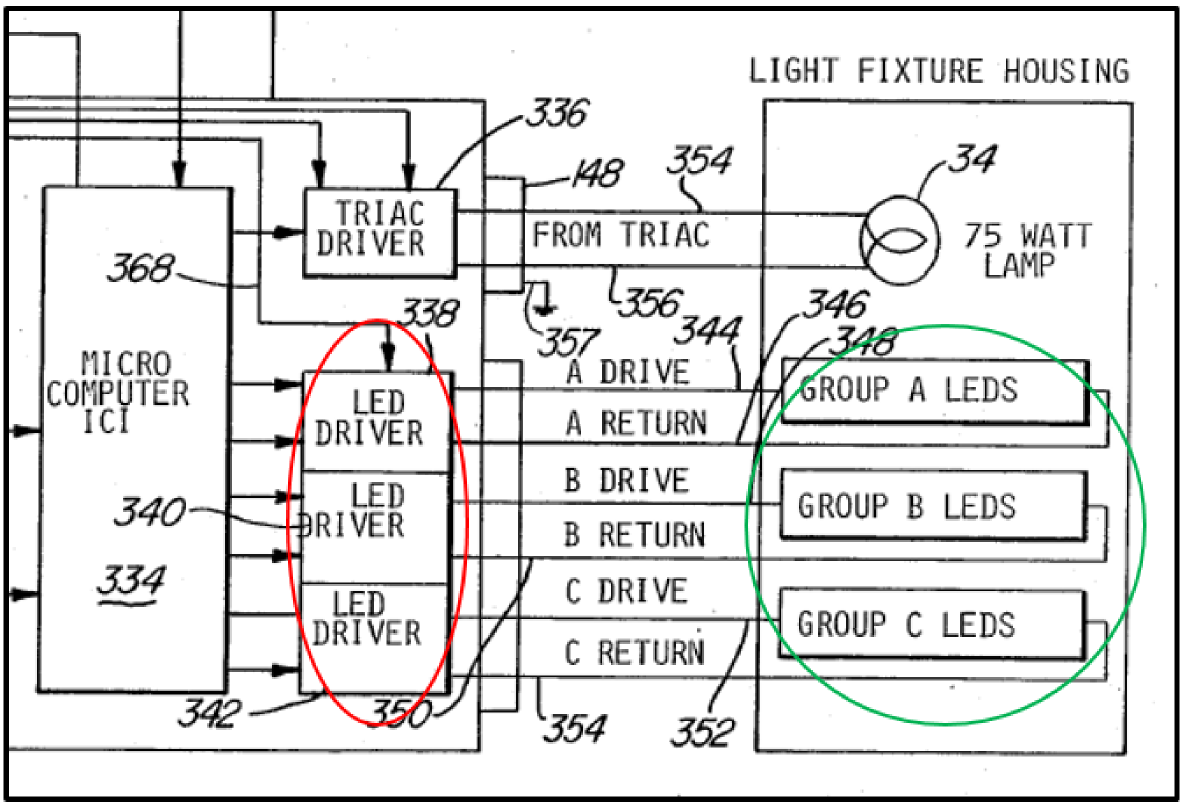
#### 1. Claim 4

##### a) The lighting system of claim 1, further comprising an antenna for receiving data.

While *Zhang* and *Salam* do not explicitly disclose an antenna for receiving data, it would have been obvious in view of *Michael* to configure the *Zhang-Salam* system to include such an antenna. (Ex. 1002, ¶¶69-72, 119-125.) *Michael* "relates to lighting assemblies," and (like *Zhang*) discloses circuitry relating to LED-based lighting. (Ex. 1008, 1:5-7; *see also id.*, Title, 7:20-8:47; Ex. 1005, Title, Abstract;

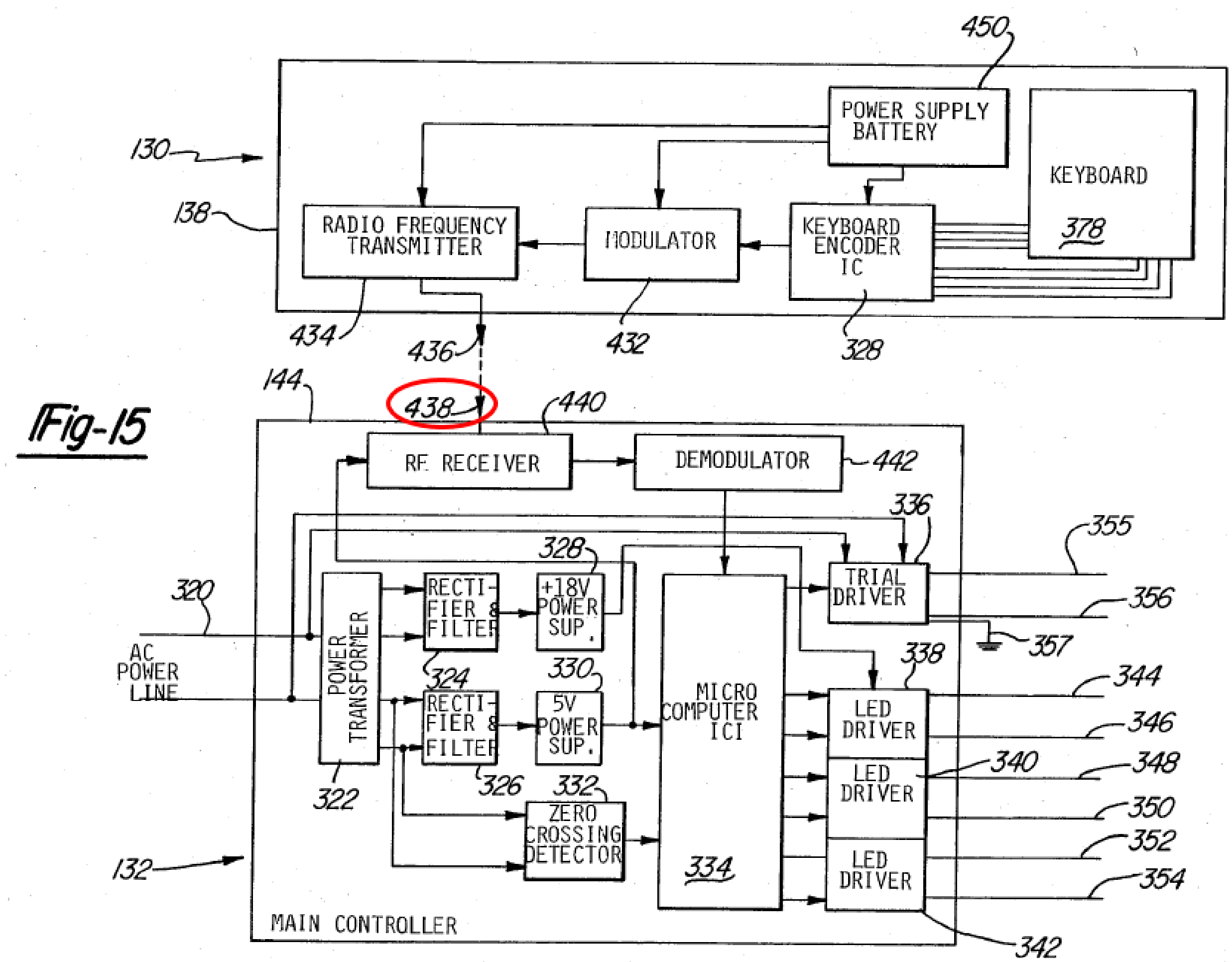
Ex. 1002, ¶¶69-72, 120.) Accordingly, a POSITA would have had reason to consider the teachings of *Michael* when implementing *Zhang*'s lighting system. (*Id.*)

*Michael* discloses a lighting assembly that includes LED drivers (red below) and LEDs (green below), as shown below in excerpted/annotated Figure 12.




(Ex. 1008, FIG. 12 (excerpted/annotated); *see also id.*, 7:20-21; Ex. 1002, ¶121.)

*Michael* discloses that an operator uses a keyboard 378 to interface with the lighting assembly and control it. (Ex. 1008, 8:23-24, 8:54-58, FIG. 15 (below; showing keyboard 378 at top right); Ex. 1002, ¶122.) For example, *Michael* discloses controlling the color of lighting and/or turning off lighting based on operator input (Ex. 1008, 8:29-34, 8:58-66) and further discloses that a "bulb 34 may be caused to glow with whatever intensity is desired" based on such operator input (*id.*, 8:67-9:2). (Ex. 1002, ¶122.) *Michael* explains that, by driving an appropriate current to LEDs, the system controls light emitted by the LEDs. (Ex. 1008, 9:2-9; Ex. 1002, ¶122.) *Michael* describes using wireless communication for controlling the LEDs of the lighting assembly. (Ex. 1008, 10:48-61; Ex. 1002, ¶122.) For such wireless communication, *Michael* discloses a receiving antenna 438 (red below), shown in Figure 15:




(Ex. 1008, FIG. 15 (annotated); Ex. 1002, ¶122.)

*Michael* explains that keyboard 378 is coupled to keyboard encoder IC 328, which provides an encoded signal that is modulated and transmitted to antenna 438, and "[t]he signal received on antenna 438 is inputted to a radio frequency receiver 440 ... [which] outputs to a demodulator 442 which outputs to microcomputer 334." (Ex. 1008, 10:48-58.) *Michael* discloses that the operator enters input via keyboard 378 in the form of commands (represented by the foregoing encoded signal), and a POSITA would have understood the commands and/or the modulated version thereof to be *data*. (*Id.*, 8:23-29; Ex. 1002, ¶123.) As shown above in Figure 15, microcomputer 334 is coupled to LED drivers 338/340/342. (Ex. 1002, ¶124.) Thus, antenna 438 receives data for operating/driving LEDs. (*Id.*)

Usage of an antenna, including for communicating with and controlling a device wirelessly, was conventional and well known in various engineering contexts, including in the context of lighting systems, long before the alleged invention of the '149 patent. (Ex. 1002, ¶124.) For example, *Wacyk* describes antenna-based control of a lamp. (*Id.*; Ex. 1020, FIGS. 2-5, 7.)[11] As shown below in Figure 4A of *Wacyk*, a receive antenna 112 (red below) and a radio transceiver coupled to the antenna 112 are used for receiving data signals, which are sent to a microcontroller 110 for controlling a lamp driver 106. (Ex. 1002, ¶124.)

[11] Exhibit 1020 demonstrates the state of the art. (Ex. 1002, ¶124.)

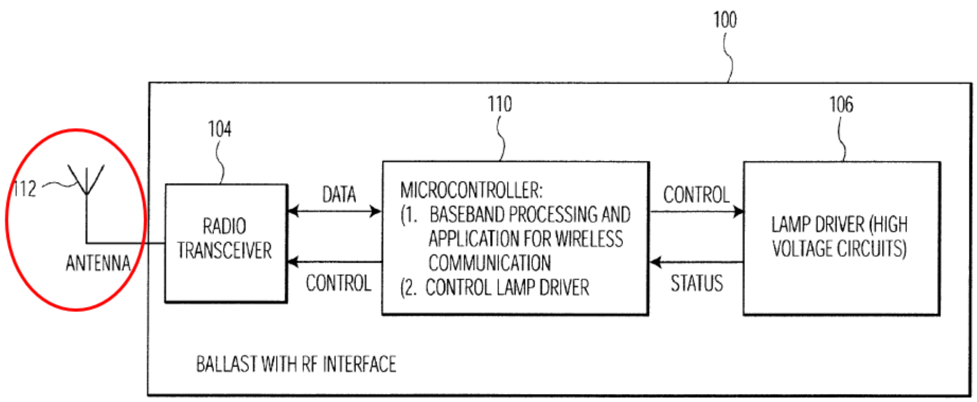



FIG. 4A

(Ex. 1020, FIG. 4A (annotated); *see also id.*, 4:7-16; Ex. 1002, ¶124.)

In light of *Michael*'s teachings and the state of the art (*e.g.*, as demonstrated by *Wacyk*), a POSITA would have been motivated to configure the *Zhang-Salam* system to include an antenna for receiving data. (Ex. 1002, ¶125.) A POSITA would have found this to be a predictable, and indeed expected, way to implement wireless communication with the *Zhang-Salam* lighting system, in order to control it. (*Id.*) A POSITA would have found it beneficial to enable wireless communication with *Zhang-Salam*'s lighting system via such an antenna, *e.g.*, in order to provide alternative and/or additional ways control lighting, particularly given that wireless control of lighting systems was known. (*Id.*; Ex. 1009, ¶¶[0032], [0083], [0177].)[12] A POSITA would have found such wireless communication/control useful in the context of *Zhang*'s system, *e.g.*, to turn the exit sign on/off, control the lighting to

[12] Exhibit 1009 demonstrates the state of the art. (Ex. 1002, ¶125.)

be performed in a predictable manner. (Ex. 1020, FIG. 4A; Ex. 1008, 8:23-51, FIG. 13; Ex. 1002, ¶125.) A POSITA would have found the above configuration of the *Zhang-Salam* system to be simple, within the capabilities of an ordinary artisan, and reasonably likely to be successful, as a POSITA would have been knowledgeable about antennas and the above configuration would have been a combination of known components, according to known methods, to produce the predictable result of a system that receives data using an antenna. (Ex. 1002, ¶125.) *KSR*, 550 U.S. at 416.

### D. Ground 4: Claims 5-9 Are Obvious over *Zhang* and *Piepgras*

#### 1. Claim 5

##### a) A lighting system comprising:

*Zhang* discloses an LED lighting system implementing the circuit shown in Figure 2.1 which may be used for various lighting contexts, such as an illuminated exit sign or a lighting system for providing backlighting, as discussed above for claim 1. (§IX.A.1(a); Ex. 1005, ¶¶[0032]-[0039], [0079]-[0090], FIG. 2.1; Ex. 1002, ¶¶126-135; §§IX.D.1(b)-(d).)

##### b) an LED circuit having a plurality of LEDs, wherein the plurality of LEDs includes same or different colored LEDs;

*Zhang* discloses this limitation for the reasons discussed above regarding limitation 1(b). (§IX.A.1(b); Ex. 1002, ¶128.)

**c) a proximity sensing circuit; and**

While *Zhang* does not explicitly disclose a proximity sensing circuit, it would have been obvious of *Piepgras* to modify *Zhang*'s lighting system to include one. (Ex. 1002, ¶¶73-76, 129-133.) *Piepgras*, like *Zhang*, describes LED-based lighting systems, and thus a POSITA would have had reason to consider the teachings of *Piepgras* when implementing *Zhang*'s lighting system, which is LED-based as explained above in §§IX.A.1(a)-(b). (Ex. 1009, Title ("Light Emitting Diode Based Products"), Abstract, FIG. 1 (block diagram for lighting LED lighting system); Ex. 1002, ¶¶73-76, 129.)

*Piepgras* discloses controlling a lighting device based on a proximity sensor signal. (Ex. 1002, ¶130.) For example, *Piepgras* discloses that "any of the lighting devices discussed in connection with FIGS. 32-38 or other figures may be associated with a **sensor** or other system that generates a signal," (Ex. 1009, ¶[0179]), and that "an LED-illuminated device "may respond to signals from an activation switch that is associated with a control circuit" wherein "[t]he activation switch may respond to ... **proximity**," (*id.*, ¶[0138]). (Ex. 1002, ¶130; *see also* Ex. 1009, Abstract, ¶[0186].) As an example of control, *Piepgras* explains that the lighting device may change color "based on one or more signals provided by the detector," to emit a particular color. (Ex. 1009, ¶[0179]; *see also id.* ("[A] hallway or other area may have several lighting devices where each of them is associated with a **proximity**

**detector**. **As a person walks down the hallway, the lighting devices activate**....”); Ex. 1002, ¶130.) Thus, *Piepgras* discloses proximity sensing in the context of a lighting device. (Ex. 1002, ¶130.)

In light of *Piepgras*, a POSITA would have been motivated to, and found it predictable and obvious to, modify *Zhang*’s lighting system to implement a proximity sensing circuit as claimed. (*Id.*, ¶131.) A POSITA would have recognized that proximity sensing would have been beneficial for controlling *Zhang*’s lighting system based on proximity of objects (or persons), as discussed above and as well known in the art. (*Id.*; Ex. 1021, 1:54-57; Ex. 1022, 6:24-27; Ex. 1023, 7:34-41, 7:61-64, 8:3-7; Ex. 1024, Title, Abstract, 5:60-63, FIG. 1.)[13]

It would also have been predictable and obvious in view of the knowledge of a POSITA to implement such proximity sensing in the combined *Zhang-Piepgras* system via a proximity sensing *circuit* as claimed. (Ex. 1002, ¶132.) For example, a POSITA would have known that proximity sensors (including ones in the context of a lighting system), like many other types of sensors, were conventionally implemented using a circuit, and that proximity sensing circuits were widespread

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[13] Exhibits 1021, 1022, 1023, and 1024 demonstrate the state of the art. (Ex. 1002, ¶131.)

and predictable to implement. (*Id*.; Ex. 1024, Title, Abstract, 1:6-9, 2:11-15, 3:5-6, 5:60-63, FIG. 1; Ex. 1022, Abstract; Ex. 1023, FIG. 5, 7:34-41.)

A POSITA would have found the above modification to be simple, would have been capable of implementing it, and would have had a reasonable expectation of success in such an implementation, *e.g.*, because proximity sensors and proximity sensing circuits were well known (as discussed above) and because a POSITA would have been skilled in designing/implementing circuits and various circuit components. (Ex. 1022, 5:54-55; Ex. 1002, ¶133.) Indeed, this modification would have been a mere combination of known components and technologies, according to known methods, to produce predictable results. (Ex. 1002, ¶133.) *KSR*, 550 U.S. at 416.

**d) a driver, wherein the driver is connected to the LED circuit, the driver configured to receive an input of an AC voltage from a mains power source and provide a voltage and current to the LED circuit in response to the proximity sensing circuit.**

*Zhang-Piepgras* discloses or suggests this limitation. (Ex. 1002, ¶¶134-135.) *Zhang* discloses a driver connected to the LED circuit, wherein the driver is configured to receive an input of an AC voltage from a mains power source and provide a voltage and current to the LED circuit, as discussed for limitations 1(c) and 1(f). (§IX.A.1(c), (f); *see also* §IX.A.1(b); Ex. 1005, FIG. 2.1; Ex. 1002, ¶134.) It would have been obvious to implement providing the voltage/current to the LED circuit in response to the proximity sensing circuit, for the reasons discussed above for limitation 5(c) (§IX.D.1(c)) and the reasons discussed in this section. (Ex. 1002, ¶134.)

For example, a POSITA would have known how to control voltage/current in response to circuit-related activities/operations, including activities/operations relating to a proximity sensing circuit. (Ex. 1022, 6:24-27; Ex. 1023, 7:61-64; Ex. 1002, ¶135.) Indeed, controlling voltage and current was known to be a fundamental aspect of circuits, because voltage and current are basic circuit concepts. (Ex. 1002, ¶135.) A POSITA would have sought to provide voltage/current to the LED circuit of the *Zhang-Piepgras* system in response to the proximity sensing circuit, so that operation of the LED circuit (including lighting of LEDs) is controlled based on proximity of an object (or person)—a desirable feature, within the capabilities of a POSITA, and predictable for a POSITA to implement with a reasonable expectation of success as explained above for limitation 5(c). (*Id.*; §IX.D.5(c).)

### 2. Claim 6

#### a) The lighting system of claim 5, wherein the proximity sensing circuit turns on the light when sensing a person.

*Zhang-Piepgras* discloses or suggests this limitation for similar reasons as discussed for limitations 5(c)-5(d). (§§IX.D.1(c)-(d); Ex. 1002, ¶¶136-137.) For example, as explained for limitation 5(c), *Piepgras* discloses that "a hallway or other area may have several lighting devices where each of them is associated with a proximity detector" so that "[a]s a person walks down the hallway, the lighting devices activate," which a POSITA would have recognized as a common and predictable usage of a proximity sensing circuit. (Ex. 1021, 1:54-57; Ex. 1024, Abstract, 5:60-63, FIG. 1; Ex. 1002, ¶136.)

Thus, it would have been predictable and obvious to configure the proximity sensing circuit of the *Zhang-Piepgras* system (§IX.D.1(c)) to turn on the light when sensing a person. (Ex. 1002, ¶137.) 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. In light of *Piepgras* and the knowledge of a POSITA (*e.g.*, as demonstrated by the foregoing references), it would have been straightforward for a POSITA, who was skilled at circuit design, to implement the above configuration. (Ex. 1002, ¶137.) Similarly, a POSITA would have had a reasonable expectation of success implementing this configuration. (*Id.*)

### 3. Claim 7

#### a) The lighting system of claim 5, wherein the driver is configured to provide DC voltage and current to the LED circuit.

*Zhang* (as modified above) discloses this limitation. (Ex. 1002, ¶¶138.) For instance, *Zhang* discloses that "[a]fter filtering by the capacitor 36, the first output of the **DC power from the rectifier 35** is sent to the regulator 37 of **5 VDC**" and "[a]fter filtering by capacitor 41, the output of the regulator lights the COBLEDES 19 through diode 43." (Ex. 1005, ¶[0084]; *see also id.*, FIG. 2.1; Ex. 1002, ¶138.) A POSITA would have understood that because DC voltage is provided to the LED circuit, DC *current* is also provided to the LED circuit, because voltage *V* is the product of current *I* and resistance *R* and thus the current is DC current when the voltage is DC voltage. (Ex. 1002, ¶138.)

#### 4. Claim 8

##### a) The lighting system of claim 5, wherein at least a portion of the plurality of LEDs is configured to be powered at the same time.

*Zhang* (as modified above) discloses this limitation. (Ex. 1002, ¶139.) As discussed for limitations 1(b) and 5(b), *Zhang* discloses an LED circuit having a plurality of LEDs (red below). (*Id.*; §IX.A.1(b), §IX.D.1(b).) *Zhang* discloses that "the output of the regulator lights the COBLEDES [chip-on-board LED exit sign] 19," which a POSITA would have understood as powering diodes 20 (annotated below) ("at least a portion of the plurality of LEDs") at the same time. (Ex. 1002, ¶139.)

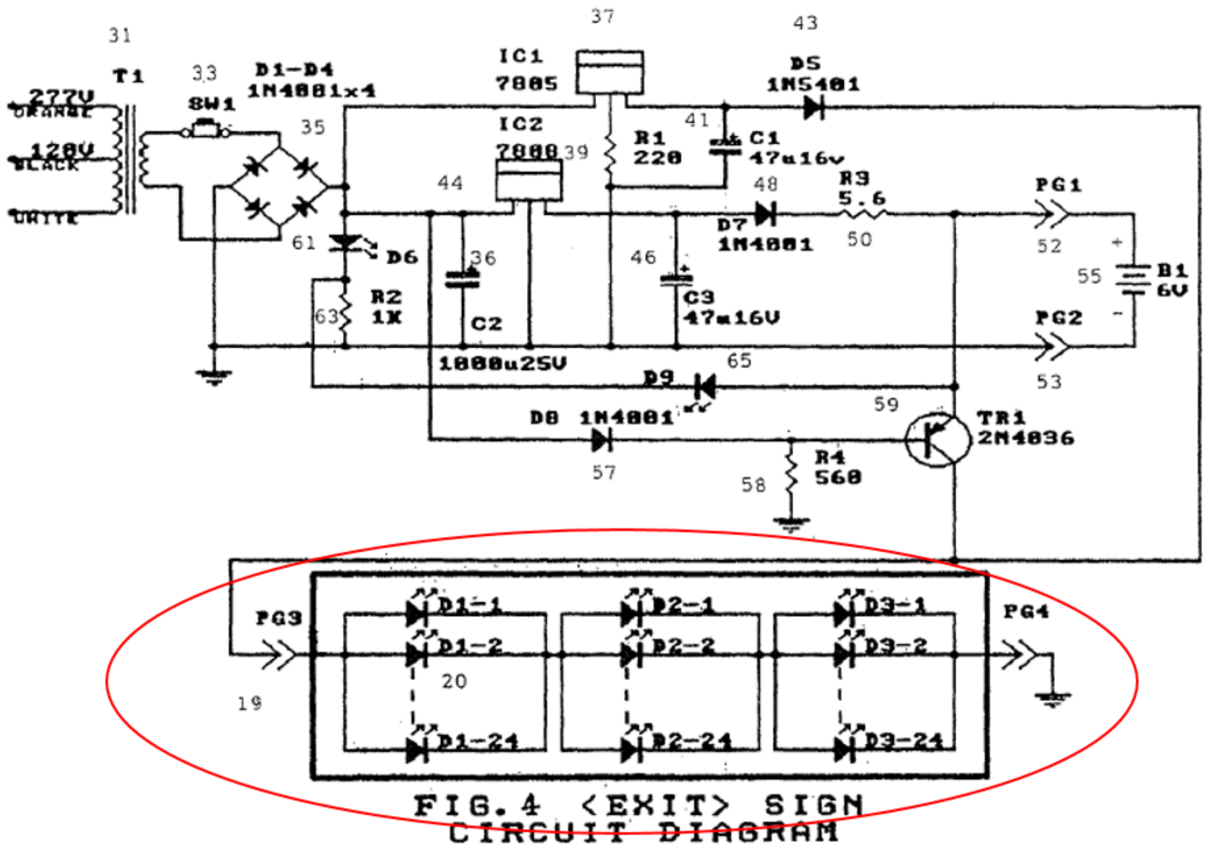



Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1005, FIG. 2.1 (annotated); Ex. 1002, ¶139.)

**5. Claim 9**

**a) The lighting system of claim 5, further comprising a reflective material.**

*Zhang* (as modified above) discloses this limitation. (Ex. 1002, ¶140.) As discussed in §IX.A.1(d), *Zhang* discloses that its lighting system includes a circuit board coated with a "layer of high **reflection material**." (Ex. 1005, ¶[0018]; *see also id.*, ¶¶[0034], [0081], Abstract.)

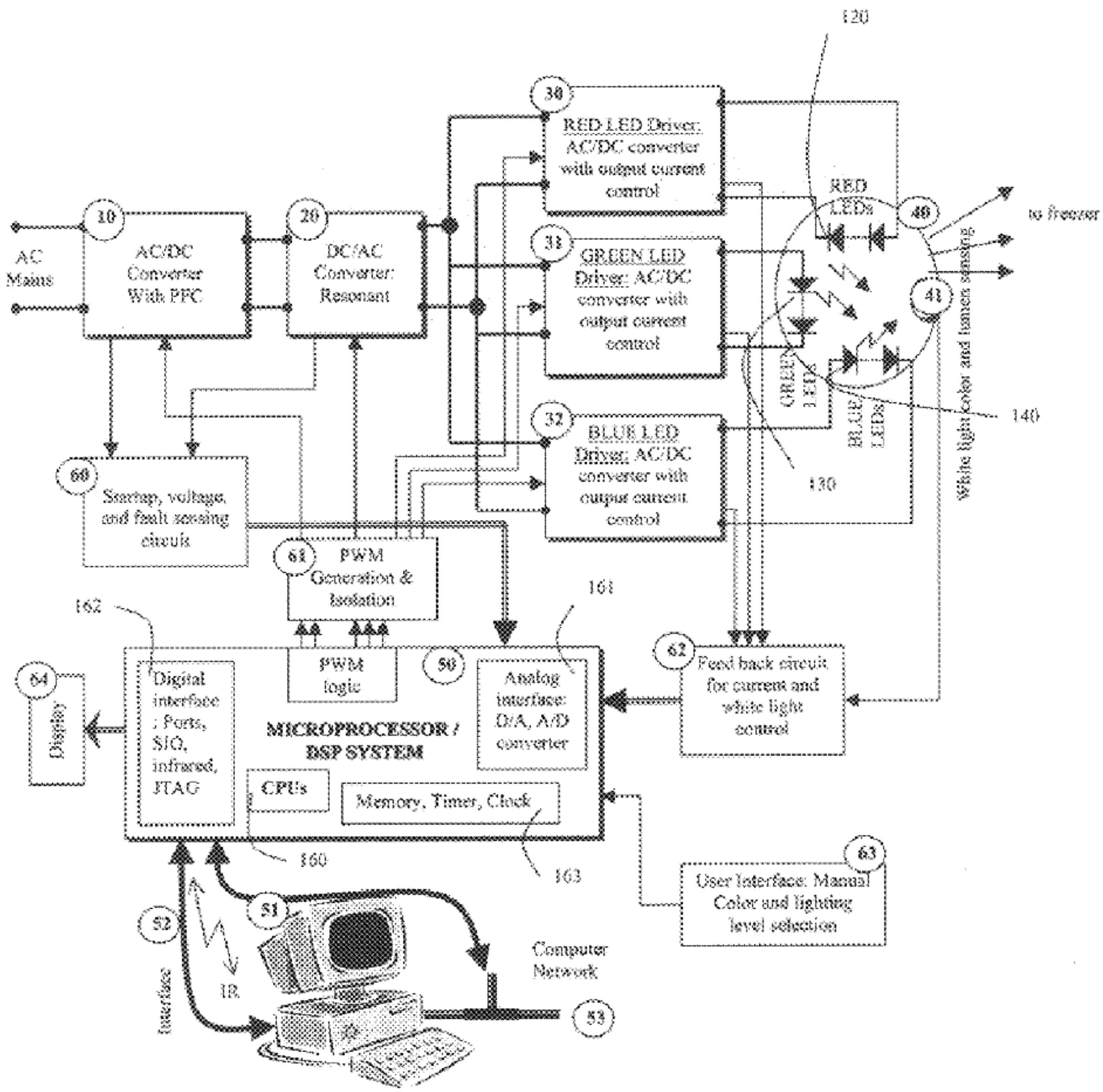
### E. Ground 5: Claim 10 Is Obvious over *Zhang*, *Piepgras*, and *Muthu*

#### 1. Claim 10

##### a) The lighting system of claim 5, wherein the driver includes a field effect transistor and is configured to receive at least two different AC forward voltages.

*Zhang* in view of *Piepgras* and *Muthu* discloses or suggests this limitation. (Ex. 1002, ¶¶77-83, 141-146.) As discussed regarding claim 2, *Zhang* discloses that the driver (§IX.A.1(c)) is configured to receive at least two different AC forward voltages. (§IX.A.2; Ex. 1005, ¶[0036], FIG. 2.1.) While *Zhang* and *Piepgras* do not explicitly disclose a "field effect transistor" (regarding which the '149 patent does not describe any criticality, *see generally* Ex. 1001), it would have been obvious in view of *Muthu* to configure the driver of the *Zhang-Piepgras* system to include a field effect transistor. (Ex. 1002, ¶¶77-83, 141-156.) *Muthu* relates to LED circuits for providing lighting for display systems, *e.g.*, displaying products in a retail environment. (Ex. 1025, Title, Abstract, FIGS. 1-3, 1:7-12; Ex. 1002, ¶142.) Additionally, *Muthu*, like *Zhang*, describes powering LEDs with AC power. (Ex. 1025, 2:62-3:2.) Therefore, a POSITA would have found *Muthu* to be a relevant resource to consult when implementing *Zhang*'s LED lighting system. (Ex. 1002, ¶¶77-83, 142.)

*Muthu* describes an LED lighting system, including mechanisms for providing power to LEDs. (Ex. 1002, ¶143.) Figure 1 of *Muthu* (below) shows a "microprocessor controlled AC power supply system for [an] RGB LED based freezer driver." (Ex. 1025, 2:62-65.)




(Ex. 1025, FIG. 1; *see also id.*, 2:49-50 ("FIG. 1 represents a block diagram overview of the exemplary embodiment of the present invention.").)

*Muthu* discloses that "power is supplied by front-end AC/DC converter 10, high frequency DC/AC converter 20, and three load-end AC/DC converters 30, 31 and 32 for providing RGB LED drive currents" to "[r]ed, [r]reen and [b]lue LED light sources 120, 130 and 140 respectively," where each "is made of a plurality of LEDs connected in a suitable series and/or parallel configuration." (*Id.*, 2:65-3:5; Ex. 1002, ¶144.)

*Muthu* describes the use of field effect transistors (FET) for driving LEDs 120/130/140. (Ex. 1002, ¶145.) Notably, *Muthu* describes that "[t]he outputs of [] isolation circuit [61] are fed into individual **MOSFET drivers** in AC/DC converter 10, DC/AC converter 20, and LED drivers 30, 31, and 32" shown in Figure 1. (Ex. 1025, 4:33-37.) A POSITA would have known that a MOSFET was a type of FET. (Ex. 1018, 110-118; Ex. 1002, ¶¶145-146.)

In light of *Muthu*, a POSITA would have been motivated to, and found it predictable and obvious to, configure the driver of the *Zhang-Piepgras* system to implement known FET design concepts. (Ex. 1002, ¶146.) For example, a POSITA would have recognized that *Muthu*'s disclosure of MOSFET drivers in an LED lighting system would have been a predictable usage of existing transistor technology. (*Id.*) Indeed, FETs were prevalent in various electrical engineering contexts and were well known to a POSITA for controlling circuits/signals. (Ex. 1010, FIG. 5 (FET 272), 10:54-11:13 (describing FET 272); Ex. 1018, 112-117; Ex.

1002, ¶146.)[14] A POSITA would have found the usage of a FET to be beneficial, because it was a reliable technology for conditionally conducting current. (Ex. 1002, ¶146.) A POSITA would have had a reasonable expectation of success in implementing such a configuration, which would have involved the use of known technologies and techniques to produce the predictable results discussed above. (*Id.*) *KSR*, 550 U.S. at 416.

### F. Ground 6: Claims 11-16 Are Obvious over *Zhang* and *Michael*

#### 1. Claim 11

##### a) A lighting system comprising:

*Zhang* discloses an LED lighting system used for various lighting contexts, such as an illuminated exit sign or a lighting system for providing backlighting, as discussed above for claims 1 and 5. (§IX.A.1(a), §IX.D.1(a); Ex. 1005, ¶¶[0032]-[0039], [0079]-[0090]; Ex. 1002, ¶¶147-158; §§IX.F.1(b)-(e).)

##### b) at least one LED circuit having a plurality of LEDs mounted on an insulating substrate;

*Zhang* discloses this limitation. (Ex. 1002, ¶149.) As discussed regarding limitation 1(b), *Zhang* discloses a plurality of LEDs, and as discussed regarding limitations 1(d)-(e) *Zhang* discloses that the LEDs are mounted on a circuit board. (*Id.*; §IX.A.1(b), (d), (e); Ex. 1005, FIG. 2.1.) A POSITA would have understood

[14] Exhibits 1010 and 1018 demonstrate the state of the art. (Ex. 1002, ¶146.)

that *Zhang* discloses that its LEDs are mounted on an *insulating substrate*, because a circuit board necessarily includes an insulating substrate that enables current flowing through conductive pathways (*e.g.*, copper traces) to be confined the conductive pathways without flowing into the insulating substrate. (Ex. 1013, 1:10-13, FIG. 9; Ex. 1014, 1:10-18; Ex. 1002, ¶149.)[15] Indeed, a POSITA would have understood that without an insulating substrate, a circuit board would not be able to properly provide electrical circuits. (*Id.*; Ex. 1014, 1:18-21.)

**c) a data antenna; and**

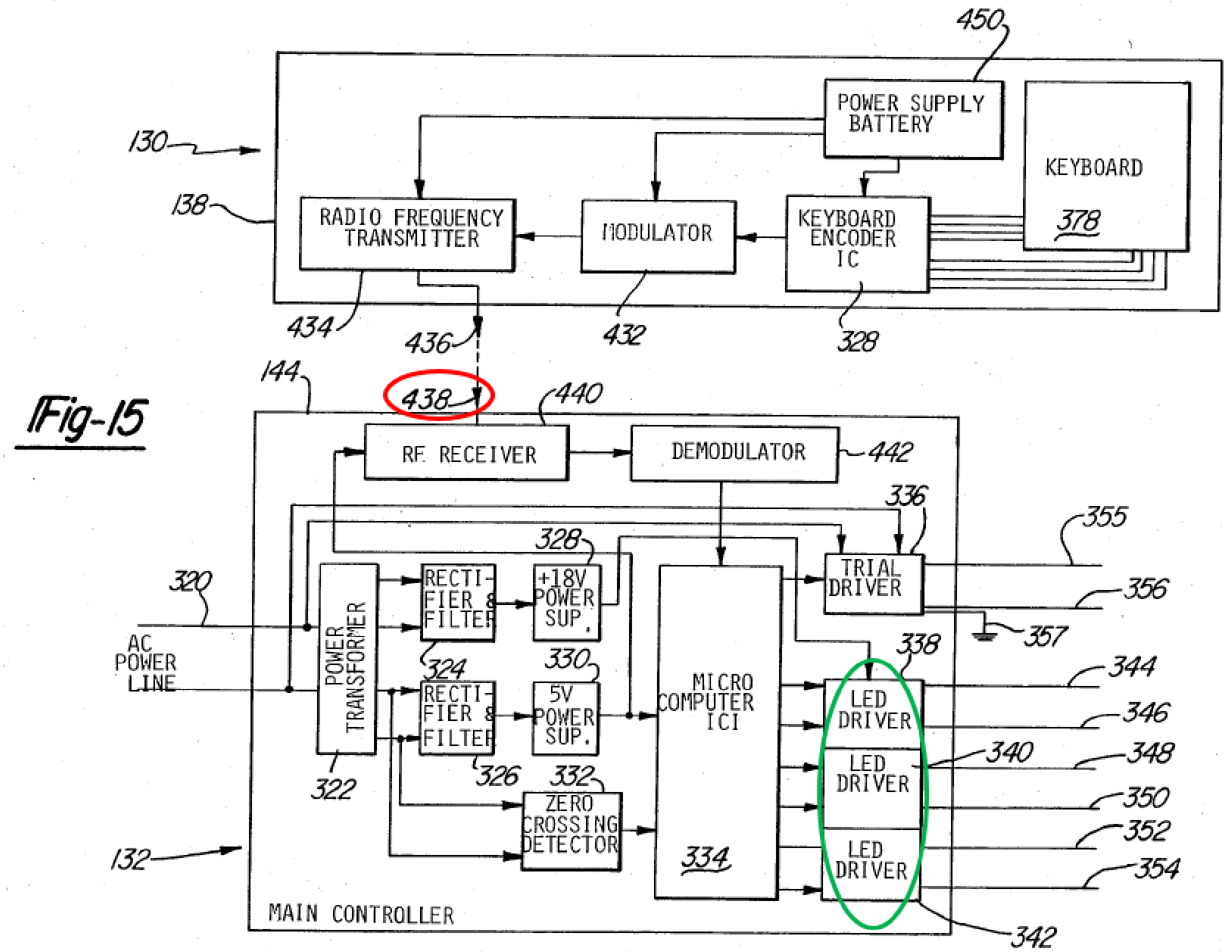
While *Zhang* does not explicitly disclose that its lighting system comprises a data antenna, it would have been obvious in view of *Michael* to implement such an antenna, for the reasons discussed above regarding claim 4. (§IX.C.1; Ex. 1002, ¶150.)

**d) a driver, wherein the driver is configured to receive data signals from the data antenna to drive the plurality of LEDs in response to signals received by the antenna,**

*Zhang* in view of *Michael* discloses or suggests this limitation. (Ex. 1002, ¶¶151-155.) As discussed above for limitations 1(c), 1(f), and 5(d), *Zhang* discloses a driver coupled to the LED circuit and configured to drive the plurality of LEDs (*e.g.*, by providing voltage and current to the LEDs). (*Id.*; §IX.A.1(c), (f),

[15] Exhibits 1013 and 1014 demonstrate state of the art. (Ex. 1002, ¶149.)

§IX.D.1(d); Ex. 1005, FIG. 2.1.) As discussed for claim 4, *Michael* discloses an antenna 438 (red below) that receives data signals that are used for sending signals to LED drivers 338/340/342 (green below) to drive LEDs in response to signals received by the antenna. (§IX.C.1; Ex. 1008, 10:48-58, FIG. 15; Ex. 1002, ¶151.)




(Ex. 1008, FIG. 15 (annotated); Ex. 1002, ¶151.)

As discussed for claim 4, *Michael* discloses that "[t]he signal received on antenna 438 is inputted to a radio frequency receiver 440 ... [which] outputs to a demodulator 442 which outputs to microcomputer 334" that sends signals to LED drivers 338/340/342 for driving LEDs. (§IX.C.1; Ex. 1008, 10:48-58; *see also id.*, FIG. 15.) *Michael* further discloses LEDs driven in response to commands entered by an operator, where commands are encoded, modulated, and transmitted wirelessly in the form of a signal that is received by antenna 438, as explained for claim 4. (§IX.C.1; Ex. 1008, 8:23-29.)

It would have been obvious in view of the combined teachings of *Zhang* and *Michael* to configure *Zhang*'s driver to *receive data signals from the data antenna* (of the combined *Zhang-Michael* system discussed for limitation 11(c)) to drive the plurality of LEDs *in response to signals received by the antenna*. (Ex. 1002, ¶152-154.) For example, a POSITA would have recognized that receiving data signals from an antenna was a conventional, expected usage of a data antenna (such as *Michael*'s antenna 438) for wireless communication and that such received data signals would predictably have been used for further processing, *e.g.*, to accomplish a task such as driving LEDs in the context of *Zhang*'s lighting system). (*Id.*) A POSITA would have found such wireless communication/control useful in the context of *Zhang*'s system, *e.g.*, to turn the exit sign on/off and/or control the lighting to be performed in a predictable manner, as discussed for claim 4. (§IX.C.1; Ex. 1002, ¶154; *see also* Ex. 1020 (demonstrating state of the art), FIG. 4A.) Indeed, wireless control of lighting was well known (*e.g.*, as discussed regarding claim 4). A POSITA would have found it desirable to control various types of lighting systems, including *Zhang*'s lighting system, via a wireless approach. (Ex. 1002, ¶154.)

A POSITA would have been capable of implementing the above configuration, including making any needed technical adaptations (*e.g.*, adding circuitry (receiver, demodulator and/or processor/microcomputer) for processing received data signals at the antenna as described in *Michael*). (Ex. 1008, FIG. 15; Ex. 1002, ¶155.) The above configuration would have been straightforward for a POSITA to implement, *e.g.*, because such usage of an antenna (including for driving LEDs in response to received data signals) was well within the state of the art, as demonstrated by *Wacyk*. (Ex. 1002, ¶155; Ex. 1020, FIG. 4A, 4:7-16.) Similarly, a POSITA would have had a reasonable expectation of success implementing this configuration, which would have been a combination of known components and technologies, according to known methods, to produce predictable results. (Ex. 1002, ¶155.) *KSR*, 550 U.S. at 416.

**e) wherein the driver is configured to provide DC voltage and DC current to the at least one LED circuit in response to data received.**

*Zhang*-*Michael* discloses or suggests this limitation. (Ex. 1002, ¶¶156-158.) As discussed regarding limitations 1(f) and 5(d), *Zhang*'s driver provides voltage/current to *Zhang*'s LED circuit. (§IX.A.1(f), §IX.D.1(d); Ex. 1002, ¶156.) *Zhang* discloses that its driver "5 VDC" to the LEDs (through diode 43, *see* Ex.

1005, FIG. 2.1), and thus a POSITA would have understood that the voltage/current provided to the LED circuit are *DC* voltage/current. (*Id.*, ¶[0084]; Ex. 1002, ¶156.) It would have been obvious in view of *Zhang* and *Michael* to configure the driver to provide the DC voltage/current to the LED circuit *in response to data received*, for at least the reasons discussed above regarding limitation 11(d) (analysis regarding driving *Michael*'s LEDs in response to a received signal representing commands entered by an operator) and the additional reasons discussed below. (§IX.F.1(d); Ex. 1002, ¶156; *see also* §IX.C.1, §IX.F.1(c).)

For example, as discussed for claim 4 and limitation 11(d), *Michael* discloses that LED drivers drive LEDs (*e.g.*, by delivering an appropriate current/voltage to the LEDs, Ex. 1008, 9:2-9) in response to data (operator commands) received from antenna 438 (and also data received from microcomputer 334, which receives a signal that was received and demodulated), to control LED lighting (*e.g.*, by controlling an LED to output light of a desired color or intensity or to turn it off). (§IX.C.1, §IX.F.1(d); Ex. 1008, 8:29-34, 8:54-9:9, FIG. 15; Ex. 1002, ¶157.) A POSITA would have understood that an LED driver drives an LED circuit by providing voltage and current. (Ex. 1002, ¶¶25-31, 157.) Therefore, a POSITA would have found it predictable and obvious in light of *Zhang* and *Michael* to configure the driver to provide the DC voltage/current to the LED circuit in response to data received, in order to enable the LED circuit to be driven based on wireless communications, which would have been recognized as a desirable feature. (Ex. 1002, ¶157.)

A POSITA would have been skilled at designing/implementing circuits and capable of implementing such a configuration and would have had a reasonable expectation of success implementing it. (*Id.*, ¶25-37, 158.) Indeed, as discussed above for limitation 5(c) (§IX.D.1(c)), switching circuits were known for conditionally controlling the flow of power to a load in response to a data signal such as a proximity signal, and similarly, a POSITA would have recognized that it was feasible and predictable to control the provision of DC voltage and DC current in response to data received. (*Id.*; *see also* §IX.F.1(d) (citations and analysis regarding driving LEDs in response to received signals); Ex. 1002, ¶¶49, 158.)

**2. Claim 12**

**a) The lighting system of claim 11, wherein the driver is configured to receive one of at least two different AC forward voltage inputs to the driver.**

*Zhang* (as modified above) discloses this limitation for the reasons discussed above regarding claim 2. (§IX.A.2; Ex. 1002, ¶159.)

**3. Claim 13**

**a) The lighting system of claim 11, wherein data is sent and received via the data antenna.**

*Zhang-Michael* in view of the state of the art discloses or suggests this limitation. (Ex. 1002, ¶¶160-162.) As discussed for limitation 11(d) (§IX.F.1(d)), *Zhang-Michael* discloses *receiving* data via a data antenna. To the extent *Zhang-Michael* does not explicitly disclose that data is also *sent* via the data antenna, it would have been obvious to implement this feature. (Ex. 1002, ¶¶160-162.) A POSITA would have known that a data antenna was usable for both sending and receiving data. (*Id.*) Indeed, sending/receiving data using an antenna were basic aspects of wireless communications, known decades before the alleged invention of the '149 patent, and a POSITA would have found bidirectional communication to be predictable and desirable, *e.g.*, because bidirectional communication enables better interactions with a remote system than unidirectional communication. (*Id.*) For example, *Caudel* describes sending and receiving data using an antenna 10. (Ex. 1059, 3:65-68, 4:3-20; Ex. 1002, ¶160.)

It was also well known to send and receive data using an antenna in the context of a lighting system. (Ex. 1002, ¶161.) For example, *Wacyk* describes sending and receiving data using antenna 112 (red below):

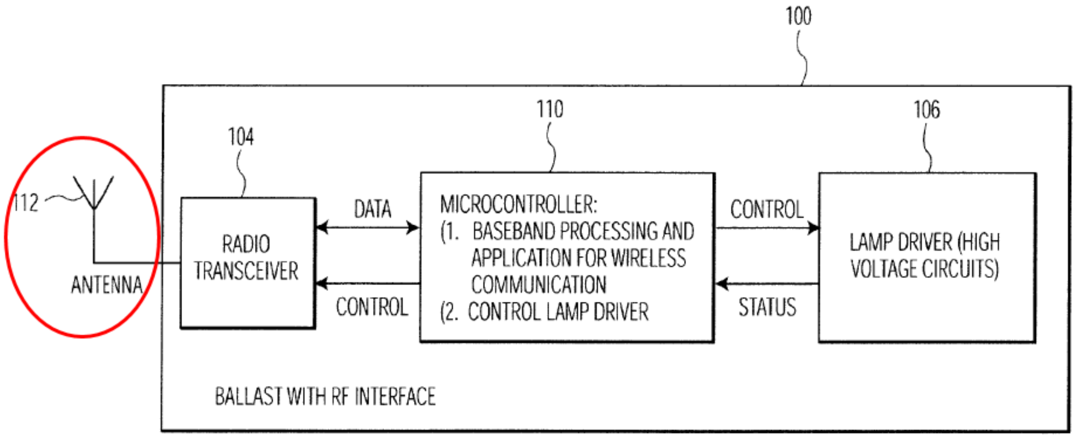



FIG. 4A

(Ex. 1020, FIG. 4A (annotated); *see also id.*, 4:7-16; Ex. 1002, ¶162.)[16]

In light of such knowledge, it would have been obvious to configure the data antenna of the *Zhang-Michael* system (§IX.F.1(c)) so that data is *sent* and received via the data antenna. (Ex. 1002, ¶162.) For example, a POSITA would have found such a configuration beneficial for enabling status information regarding LEDs to be sent, *e.g.*, as described in *Wacyk* (Ex. 1020, FIG. 4A), and for enabling acknowledgments to be sent (*e.g.*, in response to received lighting commands), consistent with basic principles of communication systems. (Ex. 1060, 6:21-26; Ex. 1002, ¶162.)[17] A POSITA would have been skilled in electrical engineering and knowledgeable about bidirectional communications, *e.g.*, using an antenna that

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[16] Exhibit 1020 demonstrates the state of the art. (Ex. 1002, ¶161.)

[17] Exhibit 1060 demonstrates the state of the art. (Ex. 1002, ¶162.)

sends/receives data. Such a skilled person would have been capable of implementing, and would have had a reasonable expectation of success in implementing the data antenna of the *Zhang-Michael* system so that data is both sent and received via the data antenna, which would have involved the use of known technologies and techniques to produce the expected result of sending and receiving data via an antenna. (Ex. 1002, ¶162.) *KSR*, 550 U.S. at 416.

#### 4. Claim 14

##### a) The lighting system of claim 11, wherein at least a portion of the plurality of LEDs is configured to be powered at the same time.

*Zhang* (as modified above) discloses this limitation for the reasons discussed above regarding claim 8. (§IX.D.4; Ex. 1002, ¶163.)

#### 5. Claim 15

##### a) The lighting system of claim 11, further comprising a reflective material.

*Zhang* (as modified above) discloses this limitation for the reasons discussed above regarding claim 9. (§IX.D.5; Ex. 1002, ¶164.)

#### 6. Claim 16

##### a) The lighting system of claim 11, wherein the driver includes a smoothing capacitor to smooth ripple from the output voltage.

*Zhang* (as modified above) discloses this limitation. (Ex. 1002, ¶¶165-166.) For instance, *Zhang* discloses that its driver (red below) includes a smoothing capacitor 41 (green) (labeled "C1") to smooth ripple from the output voltage.[18]

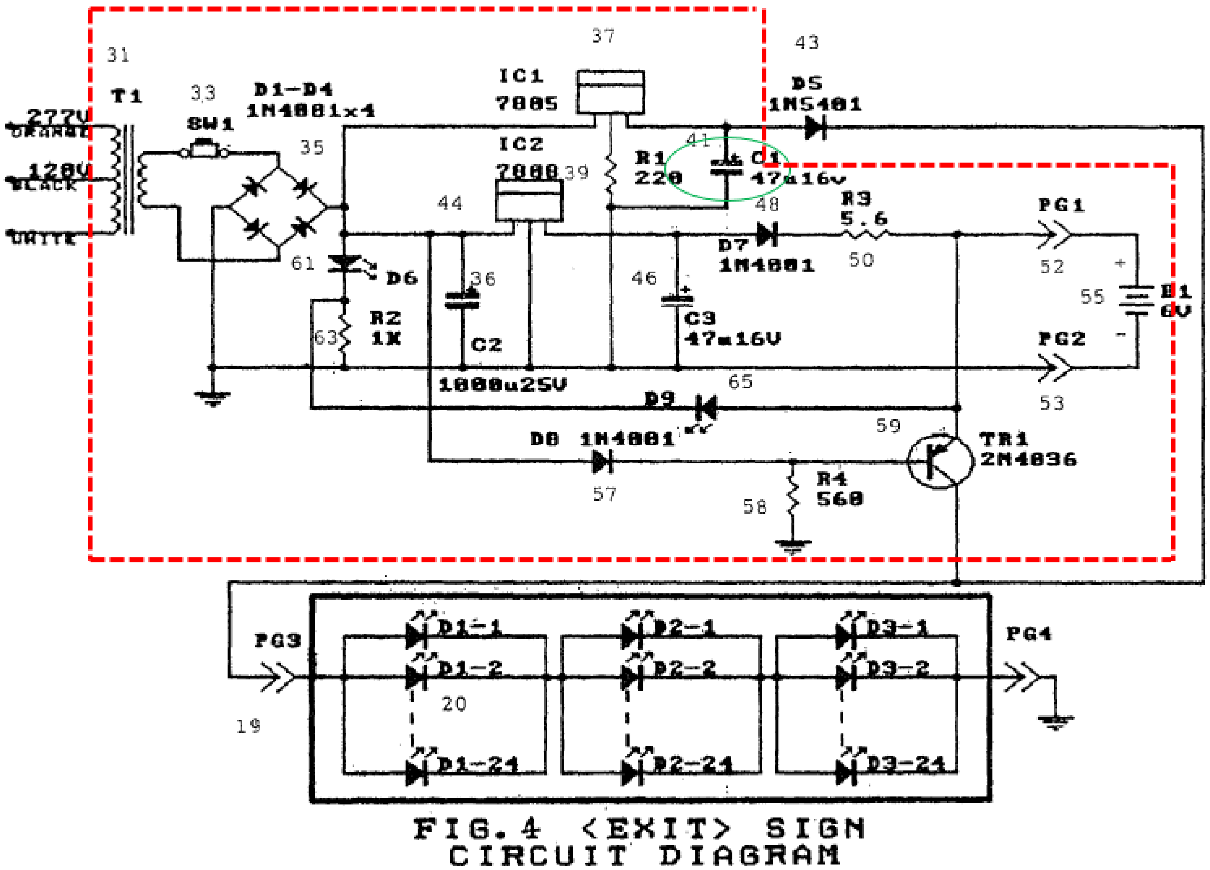


Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1005, FIG. 2.1 (annotated); Ex. 1002, ¶165.)

*Zhang* discloses that "[a]fter **filtering** by capacitor 41, the output of the regulator lights the COBLEDES 19 through diode 43." (Ex. 1005, ¶[0084].) The filtering by capacitor 41 smooths the output voltage. (Ex. 1002, ¶166.) For example,

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[18] For purposes of this proceeding, Petitioner assumes that "the output voltage" refers to the "DC voltage" recited in limitation 11(e).

*Saito* (Ex. 1019) demonstrates the understanding a POSITA would have had regarding such a capacitor, as *Saito* describes a capacitor 716 in a similar arrangement in an LED circuit and explains that it "has the function of **smoothing** the output voltage of [a] switching element 316 (voltage at a node B 715)." (Ex. 1019, ¶[0095]; *see also* Ex. 1057, 3:10, FIGS. 3B-3C (smoothing capacitor C1); Ex. 1018, 38-39.)[19] A POSITA would have understood that *Zhang*'s capacitor 41 achieves the smoothing by charging when the voltage from regulator 37 is above that of capacitor 41 and discharging (providing current from stored charge) when the voltage from regulator 37 is lower than that of capacitor 41. (Ex. 1002, ¶166.)

### G. Ground 7: Claims 17-19 Are Obvious over *Panagotacos*, *Zhang*, and *Muthu*

#### 1. Claim 17

##### a) A lighting system comprising:

As shown in Figures 1-2, *Panagotacos* discloses a system including light emitting diodes (LEDs) 14 (red below), which system a POSITA would have understood to be a *lighting* system. (Ex. 1026, FIGS. 1-2; *see also id.*, 1:5, 1:34, 5:25-27; Ex. 1002, ¶¶84-91, 167-199.)

[19] Exhibits 1019 and 1057 demonstrate the state of the art. (Ex. 1002, ¶166.)

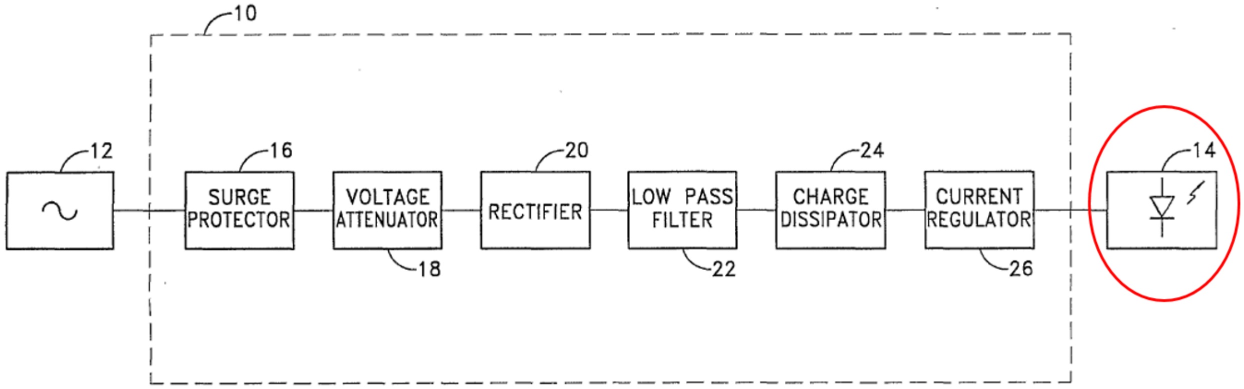


FIG. 1

(Ex. 1026, FIG. 1 (annotated); *see also id.*, 2:30-3:7; Ex. 1002, ¶168.)

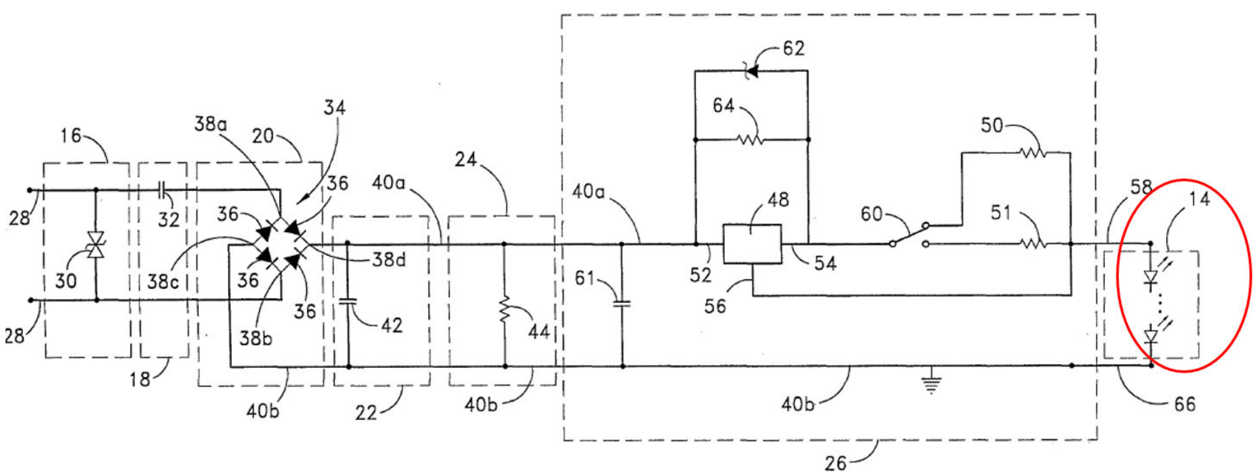


FIG. 2

(Ex. 1026, FIG. 2 (annotated); *see also id.*, 3:8-6:16; Ex. 1002, ¶168; §§IX.G.1(b)-(f).)

**b) an LED circuit having at least two LEDs mounted on a substrate, wherein the at least two LEDs may produce the same or different color of light,**

*Panagotacos* in view of *Zhang* discloses or suggests this limitation. (Ex. 1002, ¶¶169-172.) As illustrated, *Panagotacos* discloses an LED circuit (red below) having multiple LEDs 14. (Ex. 1026, FIG. 2; *see also id.*, 2:19-20 ("FIGURE 2 is a schematic **circuit** diagram..."), 2:30 ("light-emitting diodes (LEDs) 14"), 5:25-27, 5:33-34; Ex. 1002, ¶169.) LEDs 14 "may produce the same or different color of light" as claimed since there are no other possible options for the colored light emitted by the LEDs. (Ex. 1002, ¶169.)

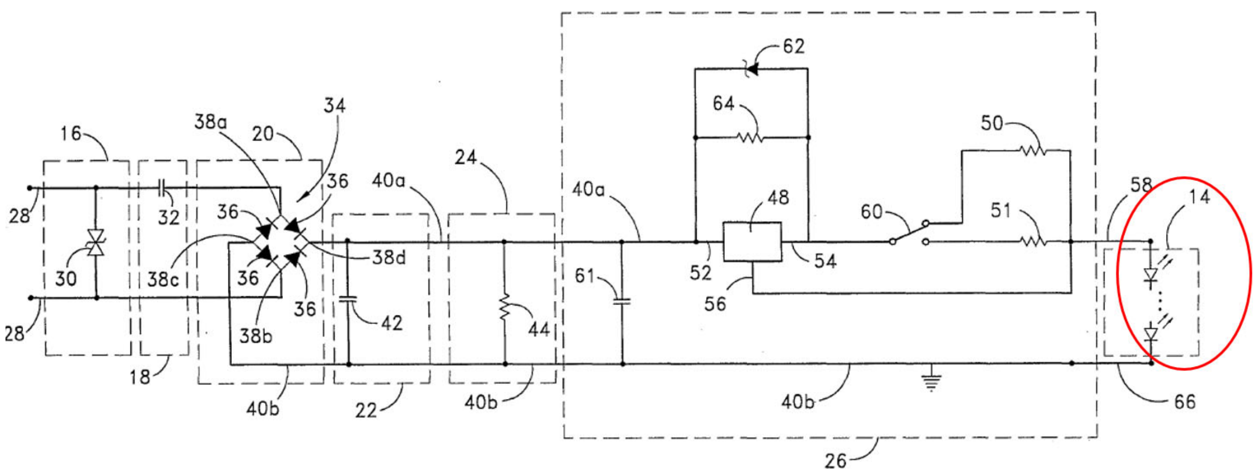


FIG. 2

(Ex. 1026, FIG. 2 (annotated); Ex. 1002, ¶169.)

To the extent *Panagotacos* does not explicitly disclose that LEDs 14 are *mounted on a substrate*, it would have been obvious in view of *Zhang* to implement this feature. (Ex. 1002, ¶¶170-172.) Both *Panagotacos* and *Zhang* describe circuits and lighting systems including LEDs. (Ex. 1026, Title, Abstract, 1:3-4; Ex. 1005, Title, Abstract, ¶[0016] (same); *see also id.*, ¶¶[0002], [0080]-[0090], FIG. 2.1; Ex. 1002, ¶170.) Therefore, a POSITA would have had reason to consider the teachings of *Zhang* when contemplating implementing *Panagotacos*' lighting system. (Ex. 1002, ¶170.)

*Zhang* discloses LEDs mounted on a circuit board. (§IX.F.1(b); Ex. 1005, FIG. 2.1; *see also* §IX.A.1(e) (explaining that components of *Zhang*'s Figure 2.1 circuit are mounted on circuit board); Ex. 1002, ¶171.) A POSITA would have understood that the circuit board is a substrate, on which *Zhang*'s LEDs are mounted. (§IX.F.1(b); Ex. 1002, ¶171.)

In light of *Zhang*, a POSITA would have been motivated to mount *Panagotacos*' LEDs 14 ("at least two LEDs") on a substrate. (Ex. 1002, ¶172.) For example, a POSITA would have found implementing LEDs in a working system predictable, and would have found a substrate to be beneficial for providing stability for the LEDs and as a base structure for forming the circuits to facilitate the flow of current between components on the substrate as known in the art. (*Id.*) A POSITA would have been skilled in circuit design and would have been capable of implementing this configuration with a reasonable expectation of success, as this would have been a mere combination of known components and technologies, according to known LED mounting methods, to produce predictable results. (*Id.*) *KSR*, 550 U.S. at 416.

**c) a driver having an input and an output, wherein the input is a high voltage low frequency input from a mains AC power source, and the output is a DC voltage and DC current provided to the LED circuit,;**

As shown below in Figure 2, *Panagotacos* discloses that its lighting system comprises a driver (red) having an input (blue) and an output (orange).

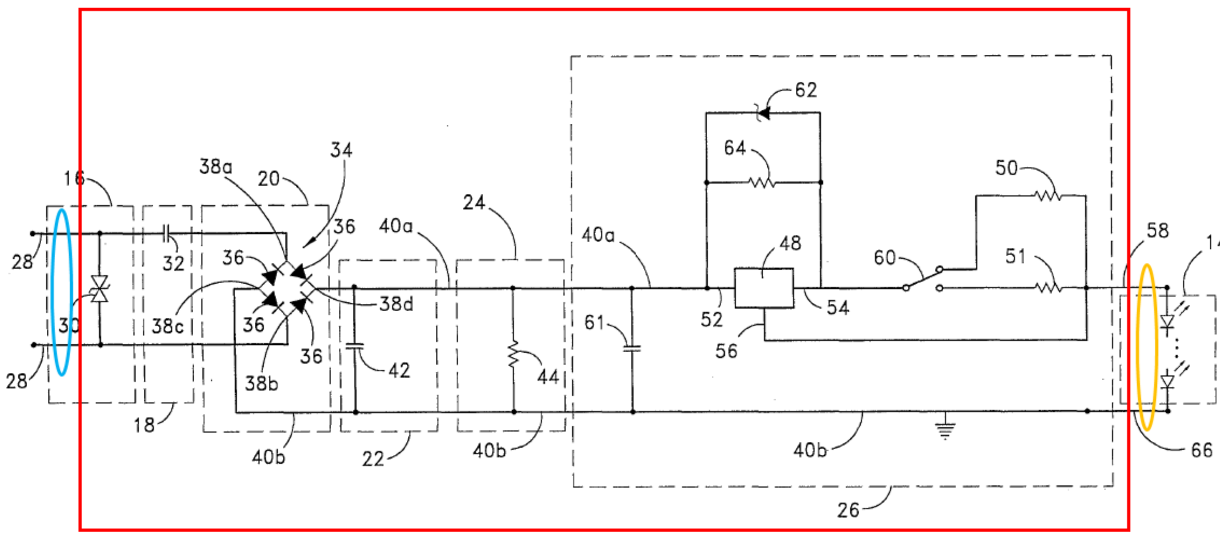


FIG. 2

(Ex. 1026, FIG. 2 (annotated); Ex. 1002, ¶¶173-180.) A POSITA would have understood that the circuitry (red) constitutes a *driver*, *e.g.*, because it drives voltage/current to LEDs 14, serving as a power supply that regulates the required power. (Ex. 1002, ¶173.)

*Panagotacos* discloses that the driver receives, at its input, AC line voltage 12, which “may be a residential or commercial AC electrical line” (Ex. 1026, 2:30-

34), such as "a 120 volt (V) residential line … or 240 volt commercial line" or a "220 V [line] as is standard for residences in Europe." (*Id.*, 3:9-11; *see also id.*, 6:1, 6:4, 7:28-29, 9:24-26, 10:1-4, 10:14-15, 10:28, 10:32, 11:25-27, 11:28, 12:5; Ex. 1002, ¶174.) A POSITA would have understood that such disclosure is a voltage input from an AC *power* source (Ex. 1026, 6:1; Ex. 1002, ¶¶25-31 (explaining that $P=V\times I$ and thus the AC line providing voltage/current also provides power)) and that residential/commercial lines refer to a *mains* AC power source. (Ex. 1027, 9:31-36; Ex. 1028, ¶[0041], FIG. 1A; Ex. 1029, 1:9-28; Ex. 1002, ¶175).[20]

A POSITA would have understood that *Panagotacos*' AC line is a *high* voltage input.[21] (Ex. 1002, ¶176.) AC line voltage 12 is attenuated by voltage attenuator (*e.g.*, a step-down capacitor 32) and thus (prior to attenuation) is a "high" voltage relative to the attenuated voltage. (Ex. 1026, 3:16-17, 3:24-27, FIGS. 1-2 (voltage attenuator 18); Ex. 1002, ¶176.) A POSITA would further have understood that *Panagotacos*' AC voltage input, having a frequency of 60Hz (*see*, *e.g.*, Ex.

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[20] Exhibits 1027, 1028, and 1029 demonstrate state of the art. (Ex. 1002, ¶176.)

[21] The '149 patent does not describe what qualifies as a "high" voltage input. For purposes of this proceeding, Petitioner submits that *Panatgotacos*' AC line voltage is a high voltage input. (Ex. 1002, ¶176.)

1026, 10:14-15), is a *low* frequency input. (Ex. 1030, 2:34-37; Ex. 1002, ¶176.)[22] Moreover, in the *Panagotacos-Muthu* combination discussed in §IX.G.1(d), the 60Hz AC voltage is converted to a DC voltage and then converted to a high frequency AC voltage, and thus the 60Hz voltage (prior to such conversion to a high frequency voltage) is a *low* frequency voltage relative to the high frequency AC voltage for that additional reason. (Ex. 1002, ¶176.)

A POSITA would have understood that the output of *Panagotacos*' driver is a DC voltage/current provided to the LED circuit. (Ex. 1002, ¶177.) As shown in Figure 2 (above), the driver output (orange) is provided to the LED circuit having LEDs 14. (Ex. 1026, FIG. 2; Ex. 1002, ¶177.) Regarding the "DC current," *Panagotacos* discloses that power supply 10 (Ex. 1026, 3:1-2), "convert[s] AC line voltage into a **DC regulated current** that is delivered to the LEDs." (*Id.*, 6:4-5; *see also id.*, 6:9-13, 7:8-9, 8:7, 8:13-14, 8:35, 9:14, 9:23, *generally* pp.10-12; Ex. 1002, ¶¶48-49, 177.)

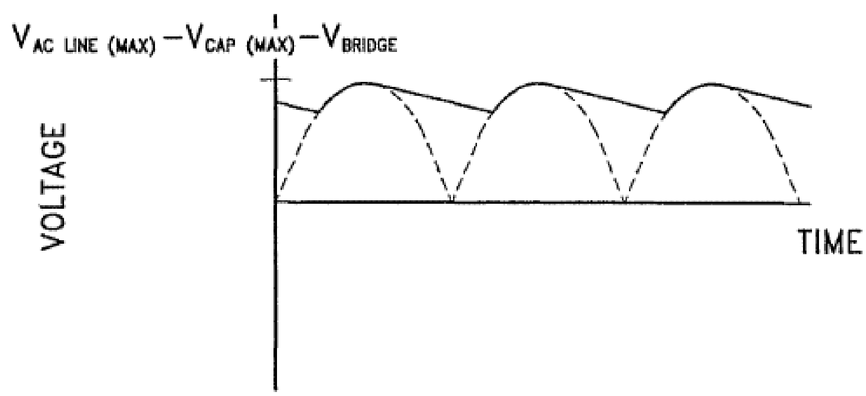
Because a DC current is provided to *Panagotacos*' LED circuit, a POSITA would have understood that the driver output is a DC voltage provided to the LED circuit. (Ex. 1002, ¶178.) For example, according to Ohm's Law, for a given LED having a constant resistance *R*, the voltage *V* is equal to current *I* (which is a DC

[22] Exhibit 1030 demonstrates the state of the art. (Ex. 1002, ¶176.)

current, as explained above) multiplied by *R*. (Ex. 1002, ¶178.) Moreover, a POSITA would have understood the driver output provides a DC voltage to the LED circuit based on the circuit shown in Figure 2, as explained below. (*Id.*)

For example, *Panagotacos* discloses that "FIGURE 3D depicts the voltage across the plus and minus conducting lines 40a and 40b [shown in Figure 2] electrically connected to two of the junctions 38c and 38d of the diode bridge 34 and to the ripple suppression capacitor 42" (Ex. 1026, 6:25-27), and a POSITA would have understood that Figure 3D (below) shows a DC voltage at the solid line plot. (Ex. 1002, ¶179.)

FIG. 3D



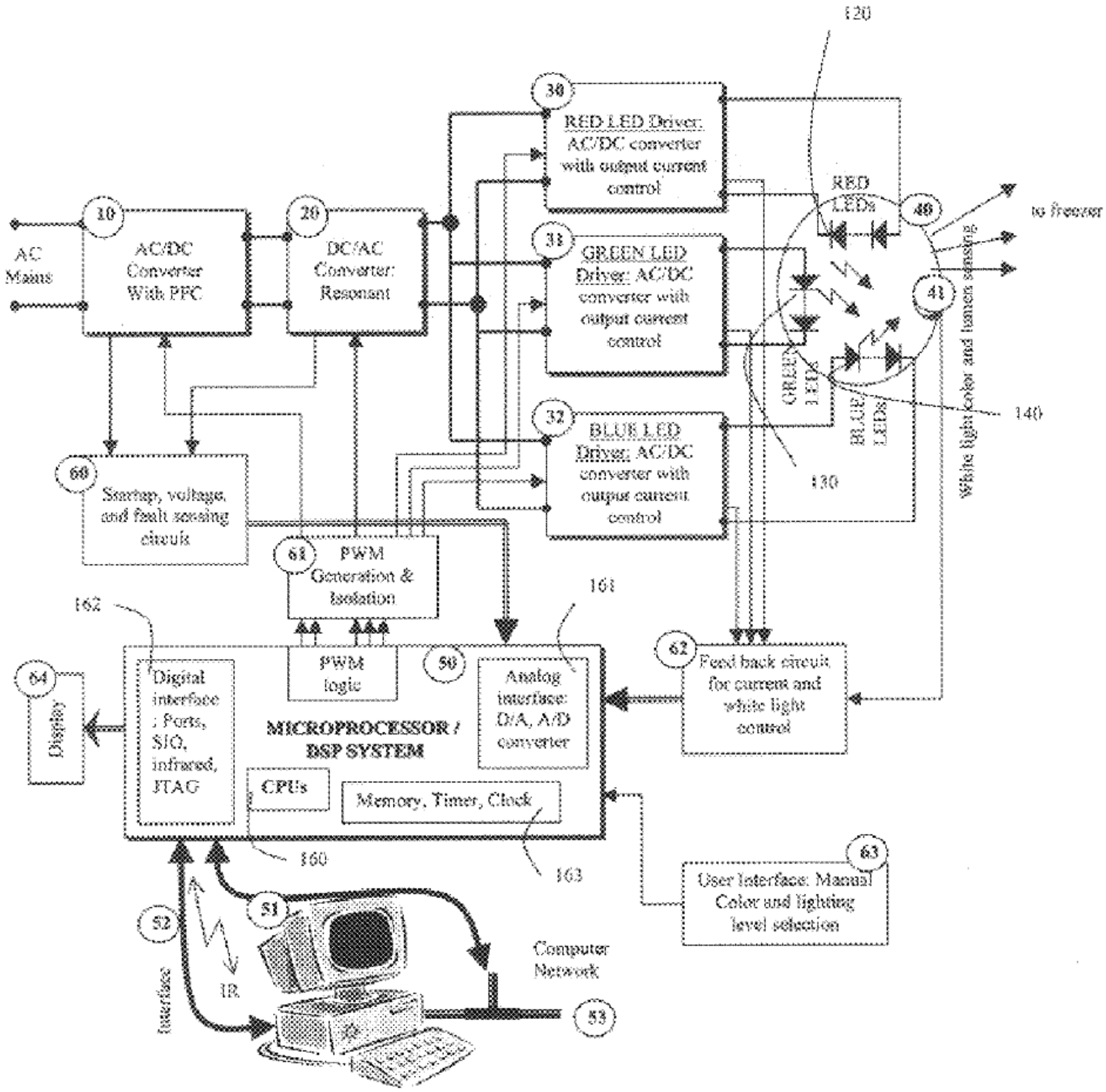

(Ex. 1026, FIG. 3D.)

Therefore, the voltage at node 52 (the input terminal of voltage regulator 48), which is equal to the voltage across lines 40a and 40b (because a voltage of a given node in a circuit is expressed relative to another node), is a DC voltage. (*Id.*, FIG. 2; Ex. 1002, ¶180.) *Panagotacos* discloses "maintain[ing] an operating voltage across the input terminal 52 and the output terminal 54 of the voltage regulator 48, corresponding to **25 V**" (Ex. 1026, 9:29-32), and thus the voltage at output terminal 54 of the voltage regulator 48 is the voltage at node 52 minus 25 V, which is also a DC voltage because a DC voltage minus a constant is another DC voltage. (*Id.*, FIG. 2; Ex. 1002, ¶180.) As shown in Figure 2 of *Panagotacos*, "[t]he voltage at the output terminal 54 is reduced by a voltage drop across the set-point resistor 50, and this reduced voltage is applied to the reference terminal 56." (Ex. 1026, 6:34-7:1.) The voltage drop across resistor 50 is a constant, and thus the voltage at terminal (which is the same as the voltage at node 58 coupled to the LED circuit) is also a DC voltage, because it is the DC voltage at terminal 54 minus a constant. (Ex. 1002, ¶¶43-49, 180.)

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

While *Panagotacos* does not explicitly disclose this limitation, it would have been obvious in view of *Muthu* to configure *Panagotacos*' system so that the driver comprises a high frequency stage, the high frequency stage providing an output frequency higher than an AC mains input frequency to the driver. (Ex. 1002, ¶¶181-192.) *Muthu*, like *Panagotacos*, relates to an LED-based lighting system and associated circuitry, including circuitry for providing power to LEDs. (§IX.E.1 (analysis regarding *Muthu*), §IX.G.1 (analysis regarding *Panagotacos*); Ex. 1025, Title, Abstract, FIGS. 1-3, 1:7-12, 2:62-65 ("AC power supply system for RGB LED based freezer driver"); Ex. 1026, Title ("Power Supply for Light Emitting Diodes"), Abstract, 1:34-2:1 ("an apparatus comprises a light emitting diode and a power supply for powering the light emitting diode"), FIGS. 1-2); Ex. 1002, ¶181.) Therefore, a POSITA would have had reason to consider the teachings of *Muthu* when contemplating implementing *Panagotacos*' LED-based lighting system as modified by *Zhang* above. (Ex. 1002, ¶181.)

As explained for claim 10 (§IX.E.1), Figure 1 of *Muthu* (below) shows a "microprocessor controlled AC power supply system for [an] RGB LED based freezer driver." (Ex. 1025, 2:62-65.)

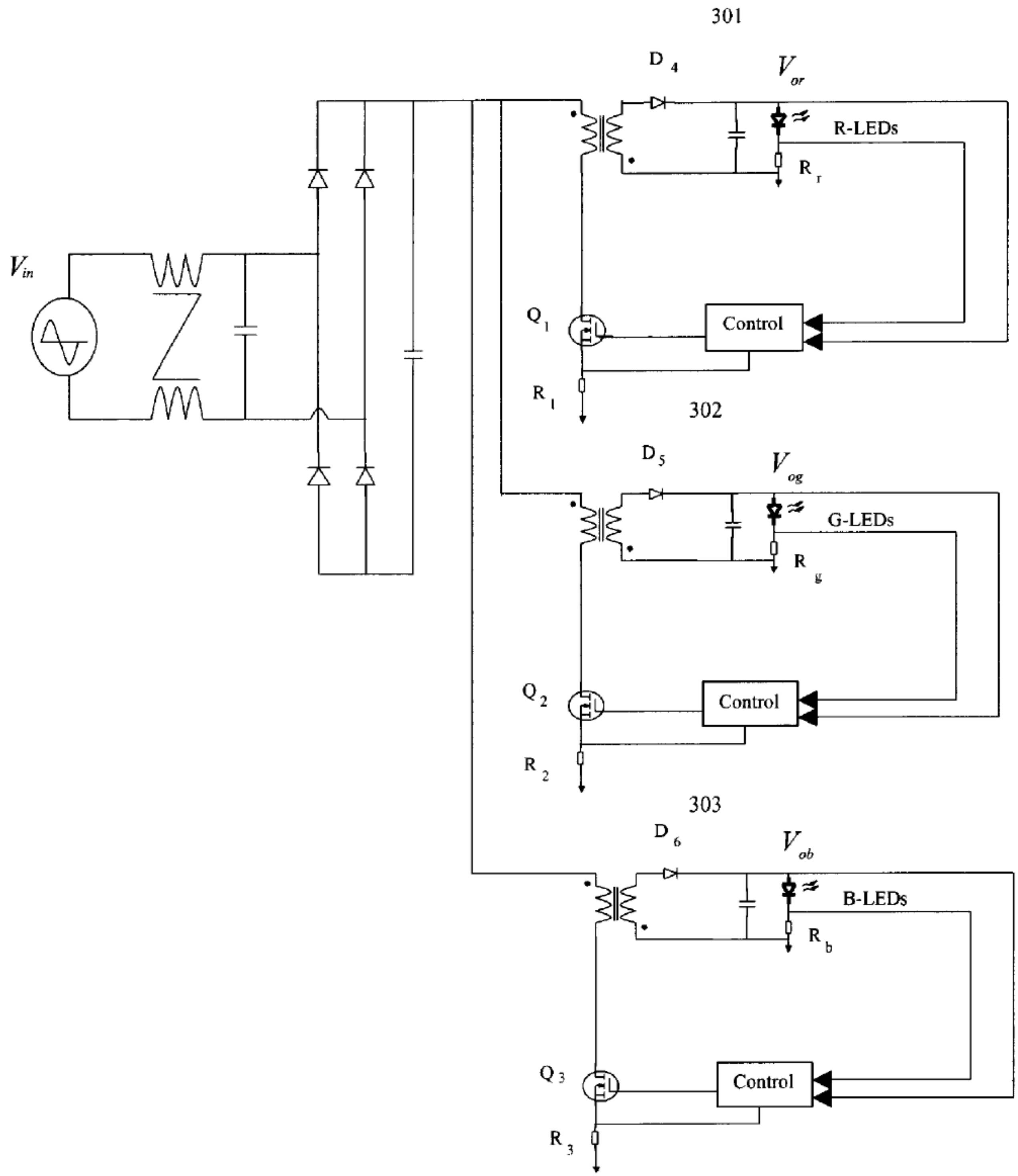



(Ex. 1025, FIG. 1; *see also id.*, 2:49-50; Ex. 1002, ¶182.)

*Muthu* discloses that AC/DC converter 10 converts an AC mains voltage to a DC voltage. (Ex. 1025, 3:25-29 ("The primary function of the front-end AC/DC converter 10 is to **convert the AC supply voltage to a DC voltage**. In addition, the AC/DC converter 10 is made to perform the power factor correction at the AC

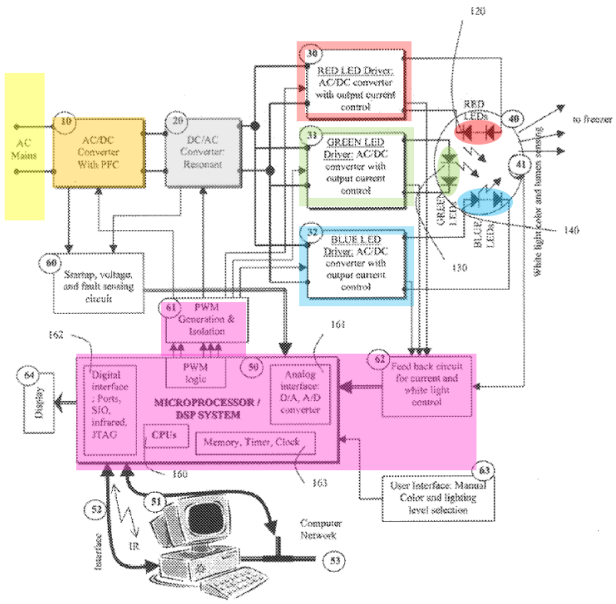
**mains**...”); Ex. 1002, ¶183.) “The output of the AC/DC converter system is connected to the input section of the **high frequency** DC/AC inverter system 20,” which “converts the DC voltage to a **high frequency** AC voltage.” (Ex. 1025, 3:45-48.) *Muthu* discloses that the output of DC/AC inverter 20 is provided as an input to AC/DC converters 30-32 (*id.*, FIG. 1), and “the outputs of the AC/DC converters 30-32 are connected to the RGB LED light sources, and provide regulated drive currents to the LED light sources 120, 130 and 140.” (*Id.*, 4:1-4.)

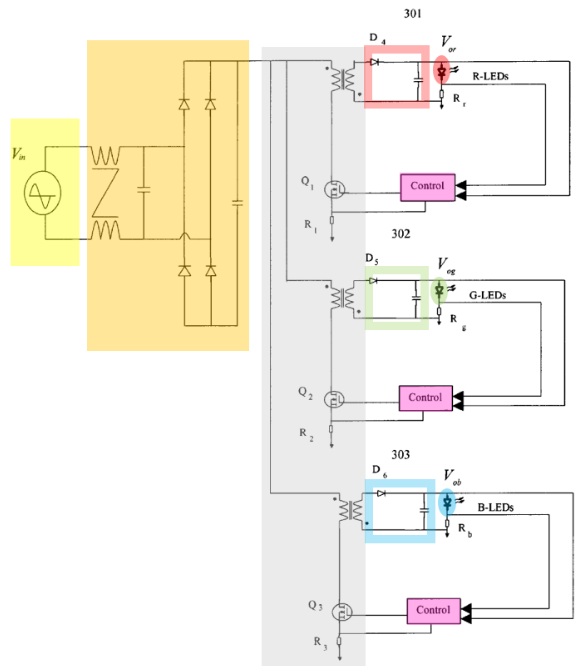
*Muthu* describes that a system represented in block diagram format in Figure 1 is realized in circuitry in, *e.g.*, the schematic diagram of Figure 3 (below). (*Id.*, 3:48-67; Ex. 1002, ¶184.)


301
$D_4$
$V_{or}$
R-LEDs
$R_r$
$V_{in}$
$Q_1$
Control
$R_1$
302
$D_5$
$V_{og}$
G-LEDs
$R_g$
$Q_2$
Control
$R_2$
303
$D_6$
$V_{ob}$
B-LEDs
$R_b$
$Q_3$
Control
$R_3$

(Ex. 1025, FIG. 3.)

The circuit shown in Figure 3 of *Muthu* implements functionality corresponding to the block diagram of Figure 1, *e.g.*, as seen by comparing annotated Figures 1 and 3 below, where colors exemplify corresponding components:




(Ex. 1025, FIGS. 1 (left), 3 (right) (each figure annotated to show AC mains in yellow, AC/DC converter in orange, DC/AC converter in gray, red/green/blue LED drivers in red/green/blue rectangles, red/green/blue LEDs in red/green/blue ovals, control subsystem in purple); Ex. 1002, ¶185.)

*Muthu* explains that Figure 3 shows “three [f]lyback converters ..., connected in parallel” for operating red, green, and blue LEDs, respectively. (Ex. 1025, 3:63-65.) Flyback converters were well known to a POSITA. (Ex. 1031, Title, Abstract, 1:15-27 (citing Ex. 1032), FIGS. 1-9; Ex. 1032, Abstract; Ex. 1002, ¶186.)[23] Each of *Muthu*'s three flyback converters shown in Figure 3 sends a control signal (*e.g.*, from *Muthu*'s control subsystem shown above in Figure 3 in purple) to a switch (*e.g.*, *Muthu*'s transistors Q1/Q2/Q3 shown in the gray annotation), to control the switch to switch on and off repeatedly and rapidly to produce a high frequency signal, which is coupled to a transformer (transformers for red, green, and blue channels are shown coupled to diodes $D_4$, $D_5$, $D_6$, respectively), which produces an AC voltage that is rectified by a diode (*e.g.*, diode $D_4/D_5/D_6$). (Ex. 1002, ¶186.)

Thus, a POSITA would have understood that *Muthu*'s system includes a driver (*e.g.*, AC/DC converter 10 (orange above) and DC/AC converter 20 (gray above), considered together) that comprises DC/AC converter 20 ("a high frequency stage"), the high frequency stage providing an output frequency higher than an AC mains input frequency to the driver. (Ex. 1025, FIGS. 1, 3; Ex. 1002, ¶187.) For example, *Muthu* explains that its DC/AC converter produces a "**high frequency** AC voltage" and it was known that such a DC/AC converter (also called an inverter) produces an AC voltage having a frequency on the order of several kilohertz, orders

[23] Exhibits 1031 and 1032 demonstrate state of the art. (Ex. 1002, ¶186.)

of magnitude higher than *Panagotacos* 60 Hz mains AC.[24] (Ex. 1025, 3:45-48; Ex. 1011, 6:33-38, FIGS. 1, 2-3 (showing inverter 32); Ex. 1002, ¶187.)[25]

In light of *Panagotacos* and *Muthu*, a POSITA would have been motivated to modify the *Panagotacos-Zhang* system to implement the features of limitation 17(d), *e.g.*, by configuring *Panagotacos*' voltage regulator as a switching voltage regulator (*e.g.*, flyback converter) as described by *Muthu*. (Ex. 1002, ¶188.) For example, *Panagotacos* discloses a voltage regulator 48 and *Muthu* describes (regarding Figure 3) a known type of voltage regulator—namely a switched mode voltage regulator known as a flyback converter (which includes the features of limitation 17(d), as explained). (Ex. 1002, ¶188.) A POSITA would have found the above modification to be predictable and desirable, *e.g.*, given that "[s]witched mode power supplies find ready use as power regulators in view of characteristics, such as, a high efficiency, a relatively light weight, a relatively small dimension, and a relatively low power dissipation" (Ex. 1031, 1:15-27) and further given that a POSITA would have sought to leverage existing known and reliable technologies (such as switched mode voltage regulator, described in *Muthu* and well known in the

[24] Thus, as explained in §IX.G.1(c), *Panagotacos*' 60Hz AC mains signal is a *low* frequency input. (Ex. 1002, ¶176.)

[25] Exhibit 1011 demonstrates the state of the art. (Ex. 1002, ¶187.)

art) for implementing *Panagotacos*' system. (Ex. 1002, ¶188.) A POSITA would have recognized that producing a higher frequency than the mains frequency would have been beneficial, *e.g.*, for promoting small size of the lighting system, because by converting to a high frequency AC voltage, a large transformer would not be needed. (Ex. 1002, ¶188.)

A POSITA would have been capable of implementing the above modification of the *Panagotacos-Zhang* system in view of *Muthu* with a reasonable expectation of success. (*Id.*, ¶189.) For example, a POSITA would have been skilled in circuit design, would have been knowledgeable about voltage regulators, and would have recognized the pertinence, relevance, desirability, and predictability of implementing the above modification. (*Id.*) This would have been a straightforward and feasible modification, given that *Panagotacos* describes using a voltage regulator and *Muthu* describes a known, voltage regulator that would have been recognized as beneficial. (*Id.*) For example, as shown below, Figure 2 of *Panagotacos* discloses voltage regulator 48 having an input coupled to an output of a bridge rectifier 34 formed by four diodes 36, and having an output that (via resistor 50) is coupled to LEDs 14.

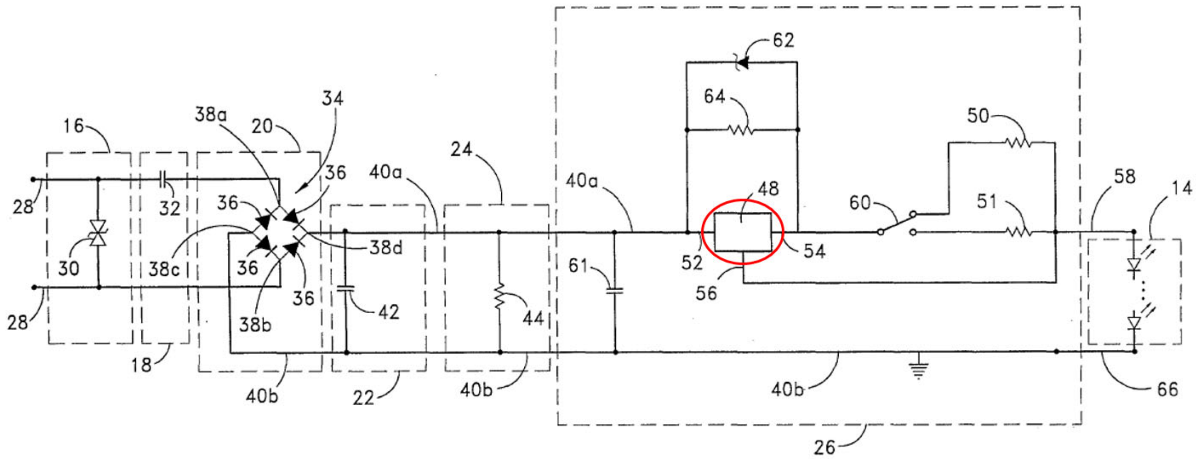
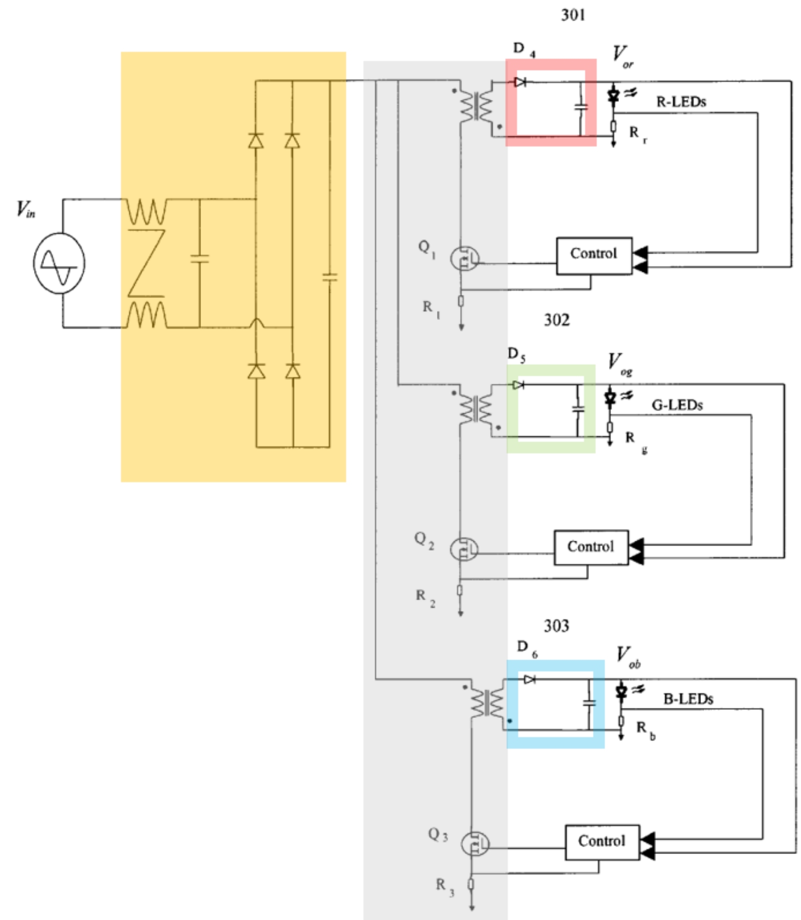



FIG. 2

(Ex. 1026 (*Panagotacos*), FIG. 2 (annotated); Ex. 1002, ¶189.)

Similarly, *Muthu*'s DC/AC inverter (grey below) produces high frequency AC voltage has an input coupled to the output of a four-diode rectifier (in the orange-annotated region below) and is coupled at its output to an AC/DC converter (*e.g.*, red/green/blue annotated regions below) that provides DC voltage to LEDs:




(Ex. 1025 (*Muthu*), FIG. 3 (annotated); Ex. 1002, ¶190.)

Thus a POSITA would have been motivated to configure the *Panagotacos-Zhang-Muthu* system such that the driver in the modified system includes a high frequency stage (similar to *Muthu* (*e.g.*, grey region in Figure 3)) that provided an output frequency higher than the 60 Hz AC mains input frequency to the driver described by *Panagotacos*. (Ex. 1002, ¶191.)

A POSITA would have had the skill and capability to make any needed adaptations to produce a working combined *Panagotacos-Zhang-Muthu* system consistent with the principles of operation of *Panagotacos*' system. (Ex. 1002, ¶192.) For example, a POSITA would have known how to implement an AC/DC converter for processing the high frequency AC output of the high frequency stage, and also known how to implement control signals to switches (*e.g.*, transistors) of the high frequency stage, particularly given that *Muthu* describes such features in detail and a POSITA was skilled at circuit design/implementation, including implementation of voltage regulators. (*Id.*)

**e) wherein the driver includes at least one capacitor and at least one transistor;**

The *Panagotacos-Zhang-Muthu* combination discloses or suggests this limitation. (Ex. 1002, ¶¶193-195.) For example, *Panagotacos*' driver (red below) includes capacitors 32, 42, and 61 (green below) ("at least one capacitor"), as shown in Figure 2:

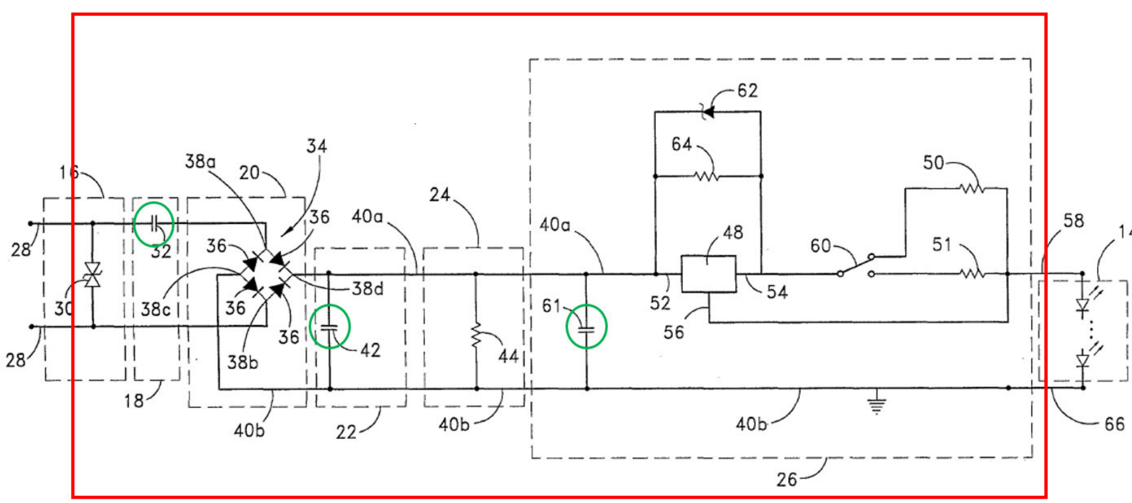
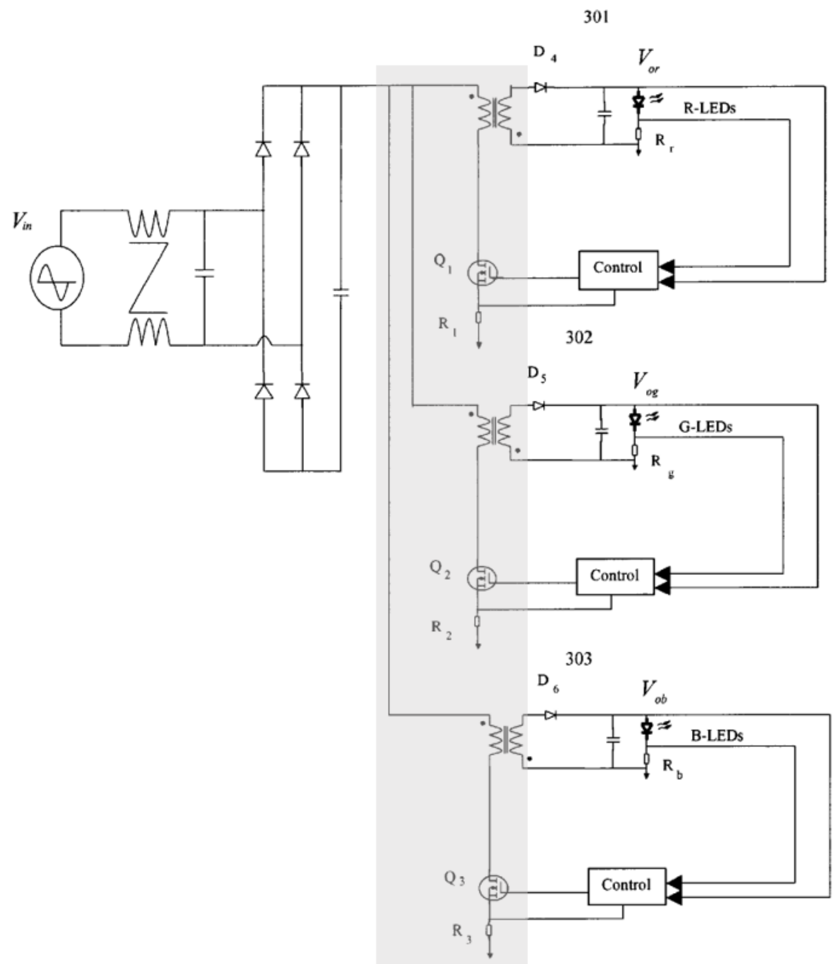



FIG. 2

(Ex. 1026, FIG. 2 (annotated); Ex. 1002, ¶193.)

Additionally, as discussed for limitation 17(d), *Muthu* discloses a high frequency DC/AC inverter (gray below) that includes transistors Q1/Q2/Q3 and thus a POSITA would have been motivated and found obvious to configure the combined *Panagotacos*-*Zhang*-*Muthu* system with a switching voltage regulator configuration that included transistors for similar reasons explained. (§IX.G.1(d); Ex. 1025, FIG. 3; Ex. 1002, ¶194.)




(Ex. 1025, FIG. 3 (annotated); Ex. 1002, ¶194.)

Thus, it would have been obvious to configure the driver in the *Panagotacos-Zhang-Muthu* system to include capacitor(s) and transistor(s) to facilitate the known operations of such a driver in the modified system for reasons similar to those explained, and because the use of transistors and capacitors in such circuitry was known (as demonstrated by *Panagotacos* and *Muthu*). (Ex. 1002, ¶195.)

**f) wherein the driver includes a bridge rectifier; and**

*Panagotacos* (as modified) discloses this limitation. (Ex. 1002, ¶196.) For instance, *Panagotacos*' driver (red below) includes a diode bridge 34 (green below) ("bridge rectifier"), as shown in Figure 2:

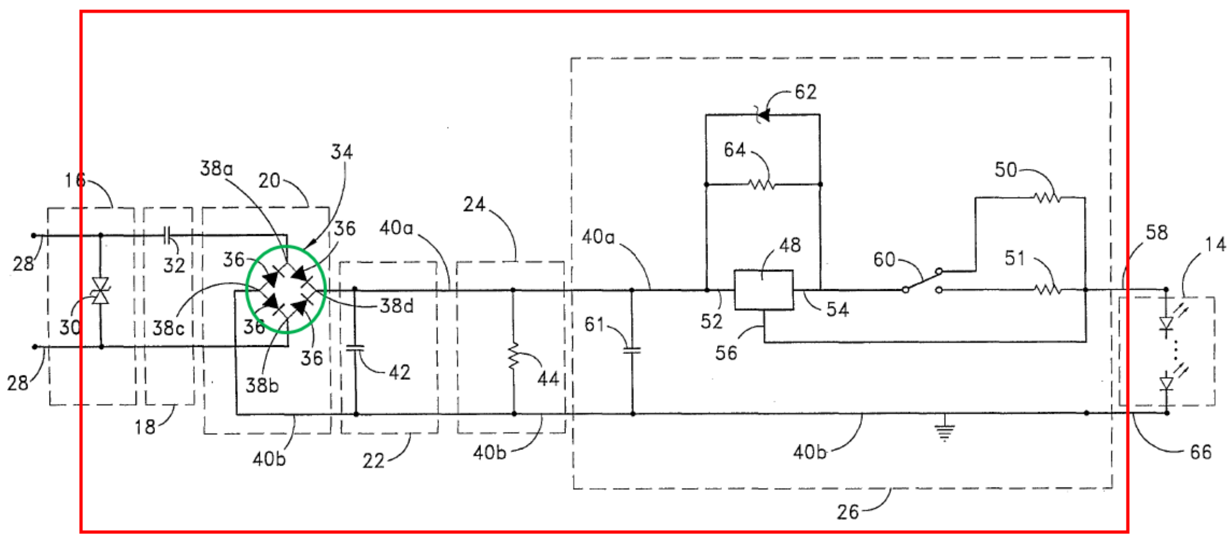



FIG. 2

(Ex. 1026, FIG. 2 (annotated); *see also id.*, 4:1-3 ("diode **bridge** 34, a type of full-wave **rectifier**"); Ex. 1002, ¶196.) Such features would have been included in the driver of the combined *Panagotacos-Zhang-Muthu* system for the reasons explained for claim elements 17(c)-(e). (Ex. 1002, ¶196.)

**g) wherein the driver includes a voltage regulator that regulates the DC voltage and the DC current provided to the LED circuit at a relatively constant level when connected to and driving the at least two LEDs.**

The *Panagotacos-Zhang-Muthu* combination discloses or suggests this limitation. (Ex. 1002, ¶¶197-199.)[26] As discussed for limitations 17(c)-(d), *Panagotacos*' system includes a voltage regulator 48 that enables a regulated DC current to be provided to the LED circuit at a relatively constant level (*e.g.*, 50 mA) when connected to and driving LEDs 14 ("the at least two LEDs"). (§IX.G.1(c) (citations and analysis regarding a DC current of, *e.g.*, 50 mA), §IX.G.1(d); Ex. 1002, ¶197.) By selecting one of resistors 51/50 using switch 60, the current through node 54 is controlled at a desired level, and that enables the DC current through LEDs 14 to be similarly controlled at a desired level. (Ex. 1026, 7:3-6; Ex. 1002, ¶197.) As explained for limitation 17(d), it would have been predictable and obvious

[26] The '149 patent discloses an "AC regulator 208" that "maintain[s] a relatively constant voltage output" but does not disclose a single regulator that "regulates [both] the DC voltage and the DC current provided to the LED circuit at a relatively constant level." (Ex. 1001, 18:21-26; *see also id.*, FIG. 29; Ex. 1002, ¶197.) Petitioner reserves the right to assert lack of written description support and indefiniteness in other proceedings. For purposes of this proceeding, Petitioner maps the prior art under the words of the claim.

in view of *Muthu* to implement *Panagotacos*' voltage regulator 48 using a switching voltage regulator (*e.g.*, flyback converter). (§IX.G.1(d); Ex. 1002, ¶197.) Thus, a POSITA would have understood that the driver of the combined *Panagotacos-Zhang-Muthu* system similarly includes a switching voltage regulator that regulates the DC current provided to the LED circuit at a relatively constant level when connected to and driving LEDs 14. (Ex. 1002, ¶197.) For example, a POSITA would have had this understanding because a switching voltage regulator was a well-known, favorably-regarded type of voltage regulator and thus would have been recognized as a way to achieve the functionality disclosed by *Panagotacos*. (*Id.*)

A POSITA would further have understood that the switching voltage regulator of the combined *Panagotacos-Zhang-Muthu* system regulates the DC voltage provided to the LED circuit at a relatively constant level when connected to and driving LEDs 14. (*Id.*, ¶198.) For example, a POSITA would have known that an LED, being a diode, has a characteristic current-voltage (I-V) curve, with current (I) being a one-to-one function of voltage (V) where one current value corresponds to one voltage value. (*Id.*) For instance, up to a certain voltage (known as the turn-on voltage of the diode), very little (or no) current flows across the diode's terminals. Beyond that certain voltage, current flows, in a manner uniquely specified by the diode's I-V curve. (*Id.*) At a given regulated current (of a relatively constant level, such as 50 mA as disclosed in *Panagotacos*, *see* §IX.G.1(c)), the I-V curve for a given LED (*e.g.*, the topmost LED 14 (red below) of Figure 2 of *Panagotacos*) thus specifies one point on the I-V curve, corresponding to one voltage. (Ex. 1002, ¶198.)

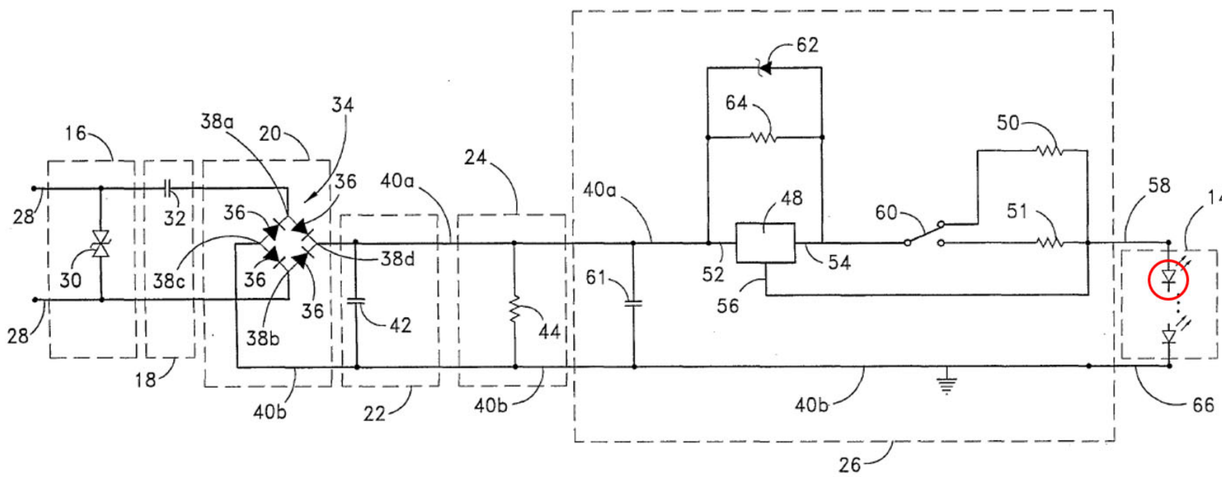



*FIG. 2*

(Ex. 1026, FIG. 2 (annotated); Ex. 1002, ¶198.)

Therefore, a POSITA would have understood that the voltage regulator of the combined system would have regulated the DC voltage provided to the LED (red circle) at the one voltage ("a relatively constant level") that is the point on the I-V curve corresponding to regulated DC current, when connected to and driving LEDs 14. (Ex. 1002, ¶199.) Accordingly, the driver in the *Panagotacos-Zhang-Muthu* system would have included a voltage regulator for the reasons discussed in §§IX.G.1(c)-(f). (*Id.*)

**2. Claim 18**

**a) The lighting system of claim 17, wherein the high frequency stage is an inverter.**

The *Panagotacos*-*Zhang*-*Muthu* combination discloses or suggests this limitation, as discussed in §IX.G.1(d). (Ex. 1002, ¶200.) Particularly, the *Panagotacos*-*Zhang*-*Muthu* combination includes, at a high-frequency stage, a DC/AC converter ("inverter") that produces a high frequency AC voltage. (§IX.G.1(d); Ex. 1025, 3:45-47; Ex. 1002, ¶200.)

**3. Claim 19**

**a) The lighting system of claim 17, wherein the substrate is mounted to a reflective heat sink.**

The *Panagotacos*-*Zhang*-*Muthu* combination discloses or suggests this limitation. (Ex. 1002, ¶¶201-202.) As discussed in §IX.G.1(b), *Panagotacos*-*Zhang* discloses/suggests LEDs 14 mounted on a substrate. As discussed in §IX.A.1(d), *Zhang* discloses an LED lamp that includes an "aluminum coated plastic bowl 3 to be used as the heat sink for a circuit board." (Ex. 1005, ¶[0092].) A POSITA would have understood that *Zhang*'s aluminum coating is a reflective heat sink. (Ex. 1005, FIGS. 3.1-4.1, Ex. 1002, ¶201.) For example, a POSITA would have known that aluminum was commonly used as a reflective material. (Ex. 1033, Title, Abstract, 1:16-17, 1:63-2:10 (citing Ex. 1034), 3:28-33, FIG. 3; Ex. 1034, 21:47-48; Ex. 1002,

¶201.)[27]

In light of *Zhang*, a POSITA would have found it obvious to configure the *Panagotacos*-*Zhang*-*Muthu* substrate to be mounted to a reflective heat sink. (Ex. 1002, ¶202.) A POSITA would have found a heat sink to be advantageous in the context of the *Panagotacos*-*Zhang*-*Muthu* lighting system, in order to reduce deleterious thermal effects associated with lighting. (*Id.*) Indeed, *Panagotacos* describes "**limiting the heat reaching the LEDs**" and thus suggests the desirability of a heat sink. (Ex. 1026, 7:34-8:1; Ex. 1002, ¶202.) Moreover, *Zhang* illustrates that a reflective heat sink in the combined system would have been a predictable, beneficial feature. (Ex. 1002, ¶202.)

Therefore, a POSITA would have found it straightforward to implement with a reasonable expectation of success the claimed combination of known components, according to known methods, to predictably reduce adverse heat effects. (*Id.*) *KSR*, 550 U.S. at 416. Such features would have been implemented in the combined *Panagotacos*-*Zhang*-*Muthu* system for the reasons stated above. (Ex. 1002, ¶202; §§IX.G.1(c)-(g).)

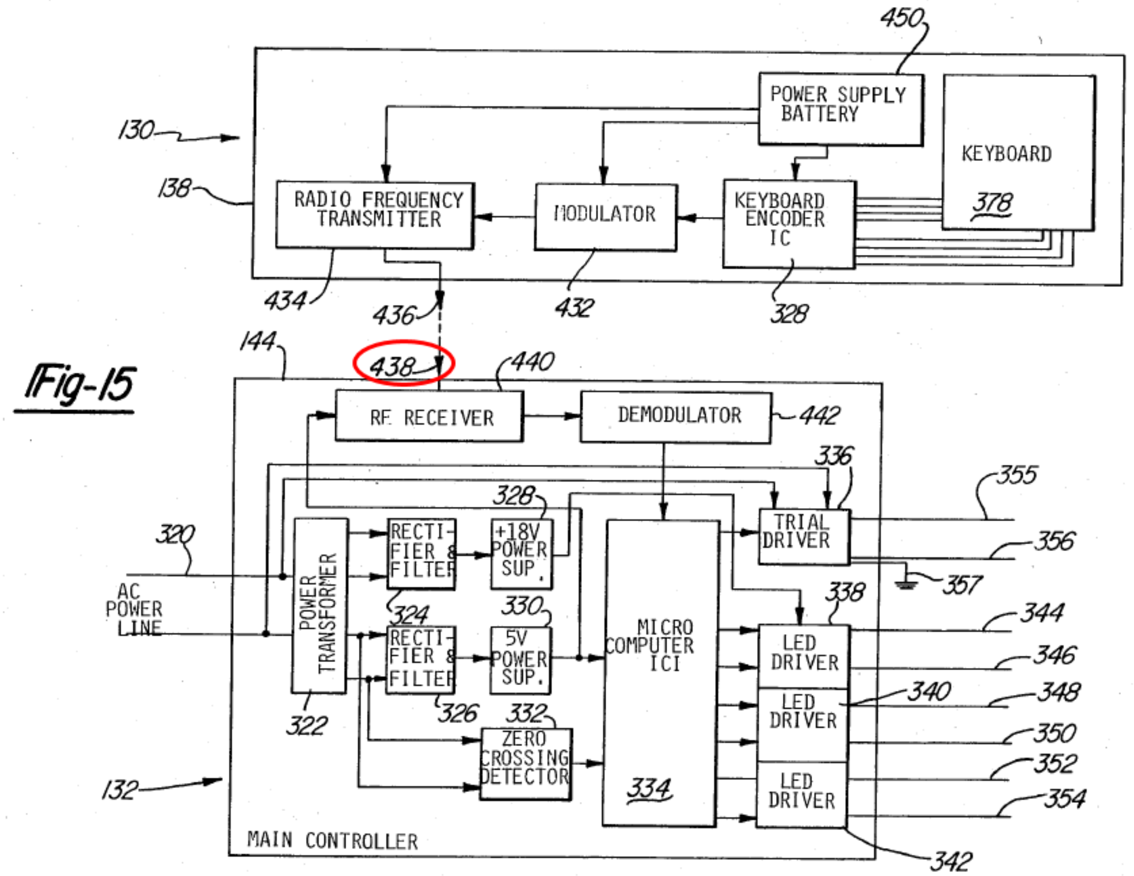
[27] Exhibits 1033 and 1034 demonstrate state of the art. (Ex. 1002, ¶201.)

## H. Ground 8: Claim 20 Is Obvious over *Panagotacos*, *Zhang*, *Muthu*, and *Michael*

### 1. Claim 20

#### a) The lighting system of claim 17, wherein the lighting system receives data from an antenna or a data transmission line.

To the extent *Panagotacos*, *Zhang*, and *Muthu* do not disclose this feature, it would have been obvious in view of *Michael*. (Ex. 1002, ¶¶203-205.) As discussed for claim 4, *Michael* discloses a lighting assembly that includes LED drivers and LEDs that can be wirelessly controlled using a receiving antenna 438 (red below) that receives data for operating/driving LEDs. (§IX.C.1; Ex. 1008, 10:48-58 (disclosing antenna 438), FIG. 15; Ex. 1002, ¶204.) In Figure 15, *Michael* shows controller 132 includes an RF receiver that receives data from antenna 438. (Ex. 1002, ¶204.)




(Ex. 1008, FIG. 15 (annotated); Ex. 1002, ¶204.)

In light of *Michael*, a POSITA would have been motivated to configure the *Panagotacos-Zhang-Muthu* system to receive data from an antenna ("from an antenna or a data transmission line"). (Ex. 1002, ¶205.) A POSITA would have recognized that receiving data from an antenna was a predictable, conventional, and expected way of implementing wireless communication for lighting systems. (§IX.C.1 (demonstrating state of the art usage of antenna for lighting systems); Ex. 1002, ¶205.) A POSITA would have been capable of implementing this configuration with a reasonable expectation of success, as it would have been a mere combination of known components and technologies, according to known methods, to produce predictable results. (Ex. 1002, ¶205.) *KSR*, 550 U.S. at 416.

## X. DISCRETIONARY DENIAL IS NOT APPROPRIATE HERE

### 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), weighs against the Board exercising its discretion to deny institution. Rather, the strong invalidity showing on the merits favors institution, notwithstanding Illinois-Litigation and HD-Litigation. (§II).

**First factor**. Petitioner intends to seek a stay in Illinois-Litigation upon institution. The Board has previously explained that 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 that 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 favor discretionary denial.

**Second factor**. Regarding Illinois-Litigation, the court has not set a trial date.[28] (Exs. 1061, 1069, 1070, 1075.) There has not been significant resource

[28] Although PO moved to transfer the Illinois-Litigation to Texas, that motion was denied. (Ex. 1068.)

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. 1061, 13; Ex. 1062, 1-2.)

The HD-Litigation is not relevant to this analysis, but nonetheless has a "tentative" trial date for December 7, 2022. (*See* IPR2021-01367, Paper 1 at 8-9; Ex. 1074, 8.) As Home Depot noted in its own petition, however, more than a dozen other trials are scheduled before the same judge—calling into question whether trial could practically take place as scheduled. (*Id*.)

**Third factor**. The minimal investment by the court and parties in 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. 1061, 1069.) This alone weighs against denial. *See*, *e.g.*, *Hulu*, IPR2021-00298, Paper 11 at 13.

**Fourth factor**. There is currently little overlap between issues raised in the petition and in the parallel proceeding. In the Illinois-Litigation, PO asserted only claims 11 and 13 of the '149 patent, while this Petition challenges all 20 claims. (§IX; Ex. 1066, 2-5; Ex. 1067, 2-43.) This weighs against denial. *See Vudu, Inc. v. Ideahub, Inc.*, IPR2020-01688, Paper 16 at 14-15 (Apr. 19, 2021). Nonetheless, to mitigate any potential concerns, Petitioner stipulates that it will not pursue invalidity of the '149 patent in district court based on any instituted IPR grounds here.

**Fifth factor.** Although Petitioner is a party to Illinois-Litigation, this factor does not outweigh the other factors that strongly weigh against discretionary denial. Petitioner is not a party to HD-Litigation.

**Sixth factor**. Petitioner diligently filed this Petition with strong grounds (§IX) **within three months** of PO's assertion of the '149 patent (Ex. 1071, ¶¶109-119), **within two months** of PO's amended preliminary infringement contentions in Illinois-Litigation (Ex. 1066), and **more than nine months before** the statutory deadline for filing an IPR (Ex. 1071, 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 '149 patent issued on first office action without any prior art analysis of issued independent claims. (Ex. 1004, 316-322.) 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 3, 6, and 17-20 of the '149 patent before the Board, thus favoring institution. *See Google LLC v. Uniloc 2017 LLC*, IPR2020-00115, Paper 10 at 6 (May 12, 2020).

### B. The *General Plastic* analysis favors institution

The Board should not exercise its discretion to deny institution based on HD-IPR (§II). Indeed, the facts and issues relevant to the factors concerning discretionary denial favor institution. *General Plastic Industrial Co., Ltd. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper No. 19 at 3, 8, 15-19 (Sept. 6, 2017).

**First factor.** Petitioner is not (and was not) a party in HD-Litigation or HD-IPR. And Home Depot is not a party to Illinois-Litigation. In short, Petitioner has no "significant relationship" with Home Depot. *See Valve Corp. v. Electronic Scripting Product, Inc.*, IPR2019-00062, Paper No. 11 at 8-10 (Apr. 2, 2019) (precedential). Home Depot and Petitioner are not co-defendants and there was/is no direction or control between the parties relating to this petition or HD-IPR. The accused products in HD-Litigation and Illinois-Litigation are different. Indeed, there is **no overlap in the originally asserted claims** of HD-Litigation and Illinois-Litigation. (Ex. 1071, ¶¶109-119 (asserting claims 11 and 13 against Petitioner); Ex. 1072, ¶¶155-167 (asserting claim 1 against Home Depot); Ex. 1073, ¶¶170-182 (same).) Also, the challenged claims do not completely overlap: claims 1-20 are challenged here whereas HD-IPR challenges only 1, 2, 4, 5, and 7-16 (hence, HD-IPR does not challenge claims 3, 6, and 17-20). Petitioner and Home Depot thus remain distinct parties, with ultimately distinct interests and litigation strategies.[29] *Paypal, Inc. v. IOENGINE,* LLC, IPR2019-00884, Paper 22 at 3-11 (Oct. 3, 2019).

**Second to fifth factors.** Since Petitioner has not previously filed a petition against the same patent, factors 2–5 bear little relevance. *Id.* Nevertheless, Petitioner has diligently invested significant effort to prepare the detailed grounds presented in this Petition, and has not delayed the preparation or filing of this Petition. When HD-IPR was filed (October 21, 2021), Petitioner was working on its strategies and challenges against the ’149 patent. Petitioner continued its efforts to prepare and file its petition soon thereafter. This is significant because of the various different compilations of conventional arrangements claimed in those claims. Thus any delay between its filing and HD-IPR was reasonable and warranted, regardless of whether Petitioner knew at the time of HD-IPR about the prior art it ultimately asserted in this petition. If anything, any delay between the filing of the petitions is a product of PO’s litigation strategy. Indeed, PO staggered its assertion of the ’149

[29] A general common interest by defendants seeking to invalidate asserted unpatentable claims should not create a significant relationship to warrant discretionary denial, especially where Petitioner asserts different prior art and challenges claims without any coordination or direction/control with Home Depot.

patent against Home Depot and Petitioner by more than 6 months. (Ex. 1072, ¶¶155-167; Ex. 1071, ¶¶109-119 (counterclaim asserting infringement of the '149 patent).)

Moreover, Petitioner filed its petition **1 week** after HD-IPR. Also, Petitioner has gained no advantage in filing its own petition. No preliminary response has been filed in HD-IPR. Moreover, as noted, Petitioner asserts different prior art, based on a different expert's opinions, against different claims (3, 6, and 17-20). Thus, **factors two through five** do not support discretionary denial. Indeed, Petitioner would be prejudiced by the denial of institution given its reasonable and significant efforts and invested resources to diligently file its petition following PO's recent infringement contentions.

**Sixth and Seventh factors.** Instituting this Petition would be no more a burden on the Board's finite resources than instituting any other petition. Indeed, this Petition challenges a finite set of claims based on a limited set of primary references. (§IX.) Nor are there any readily identifiable roadblocks for the Board to issue a final determination within the statutory one-year limit like those found in other cases where discretionary denial was exercised. *See*, *e.g.*, *Valve Corp.*, at 15.

## XI. CONCLUSION

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

Respectfully submitted,

Dated: October 27, 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. 10,517,149 contains, as measured by the word-processing system used to prepare this paper, 13,851 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 27, 2021

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

**CERTIFICATE OF SERVICE**

I hereby certify that on October 27, 2021, I caused a true and correct copy of the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 10,517,149 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)