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Paper No. 45
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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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SATCO PRODUCTS, INC.,
Petitioner,

v.

SEOUL SEMICONDUCTOR CO., LTD.,
Patent Owner.

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IPR2020-00836
Patent 7,081,722 B1

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Before ERICA A. FRANKLIN, JEFFREY W. ABRAHAM, and ELIZABETH M. ROESEL, *Administrative Patent Judges.*

FRANKLIN, *Administrative Patent Judge*.

# JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
*35 U.S.C. § 318(a)*
Granting Petitioner's Motion to Strike
*37 C.F.R. § 42.23(b)*

# I. INTRODUCTION

This is a Final Written Decision in an *inter partes* review of claims 1–3, 10–12, 15, 17–19, and 21 ("the challenged claims") of U.S. Patent No. 7,081,722 B1 (Ex. 1001, "the '722 patent"). We have jurisdiction under 35 U.S.C. § 6 and enter this Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, we determine that Satco Products, Inc. ("Petitioner") has shown, by a preponderance of the evidence, that challenged claims 1, 10, 15, 18, and 21 are unpatentable, but has not shown that challenged claims 2, 3, 11, 12, 17, and 19 are unpatentable. *See* 35 U.S.C. § 316(e).

Additionally, we grant Petitioner's Motion to Strike Exhibits. Paper 38 ("Mot.").

## *A. Procedural History*

Petitioner filed a Petition requesting an *inter partes* review of claims 1–3, 10–12, 15, 17–19, and 21 of the '722 patent. Paper 1 ("Petition" or "Pet."). Petitioner supported the Petition with the Declaration of Peter W. Shackle, Ph.D. (Ex. 1003).

Seoul Semiconductor Co., Ltd. ("Patent Owner") filed a Preliminary Response to the Petition. Paper 6 ("Prelim. Resp.").

On October 26, 2020, pursuant to 35 U.S.C. § 314(a), we instituted trial to determine whether any challenged claim of the '722 patent is unpatentable based on the grounds raised in the Petition. Paper 7 ("Inst. Dec."). The following table sets forth those grounds asserted for the challenged claims:[1]

[1] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 102 and § 103, effective March 16, 2013. Because the application from which the '722 patent issued

| Claims Challenged | 35 U.S.C. § | Reference(s) |
|---|---|---|
| 1–3, 10, 15, 19, 21 | 102/103(a) | Chiang[2] |
| 2, 3 | 103(a) | Chiang, Leung[3] |
| 11, 12, 18, 21 | 103(a) | Chiang, Hamilton[4] |
| 17, 18 | 103(a) | Chiang, Hirane[5] |

Patent Owner filed a Patent Owner Response to the Petition. Paper 21 ("PO Resp."). Patent Owner supported the Patent Owner Response with the Declaration of Regan Zane, Ph.D. Ex. 2007. Petitioner filed a Reply to the Patent Owner Response. Paper 30 ("Pet. Reply"). Patent Owner filed a Sur-reply to Petitioner's Reply. Paper 31 ("PO Sur-reply").

Petitioner filed a Motion to Strike Exhibits. Mot. Patent Owner filed an Opposition to the motion. Paper 40 ("Mot. Opp.").

On August 4, 2021, the parties presented arguments at an oral hearing. Paper 39. The hearing transcript has been entered in the record. Paper 43 ("Tr.").

### *B. Real Parties-in-Interest*

Petitioner identifies Satco Products, Inc., as the real party-in-interest. Pet. 1. Patent Owner identifies Seoul Semiconductor Co., Ltd. and Seoul Viosys Co. Ltd. as the real parties-in-interest. Paper 4, 2.

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has an effective filing date prior to March 16, 2013, the pre-AIA versions of § 102 and § 103 applies.

[2] Chiang, US 2004/0233145 A1, published Nov. 25, 2004 ("Chiang," Ex. 1004).

[3] Leung, US 2003/0164809 A1, published Sept. 4, 2003 ("Leung," Ex. 1005).

[4] Hamilton et al., *Basic Integrated Circuit Engineering*, McGraw-Hill, Inc., 1975 ("Hamilton," Ex. 1006).

[5] Hirane et al., US 5,138,310, issued Aug. 11, 1992 ("Hirane," Ex. 1007).

### *C. Related Proceedings*

Petitioner and Patent Owner provide notice that the '722 patent is at issue in the following pending federal district court litigation: *Seoul Semiconductor Co., Ltd. v. Satco Products, Inc.*, No. 2:19-cv-04951 (E.D.N.Y.). Pet. 1; Paper 4, 2.

### *D. The '722 Patent*

The '722 patent relates to a method and a circuit for driving a string of light emitting diodes ("LEDs") in multiphase. Ex. 1001, 1:7–8. The Specification describes the method as "driv[ing] a string of LEDs divided into groups, the groups of LEDs are turned on in sequence as voltage applied to the string of LEDs gradually increases." *Id.* at 1:9–12. The LED groups are "electrically connected to each other in series, and each group is separately coupled to a ground." *Id.* at 1:41–43. As the power source input voltage increases, the group immediately downstream from the power source turns on first, and thereafter the groups downstream from the string are turned on, in turn, as the input voltage increases. *Id.* at 1:46–50. Each group represents one phase of the string. *Id.* at 1:42–43. "A phase switch is provided for each group. Each phase switch is coupled between a corresponding group and the ground." *Id.* at 1:51–52.

Figure 1 of the '722 patent is set forth below:

Figure 1

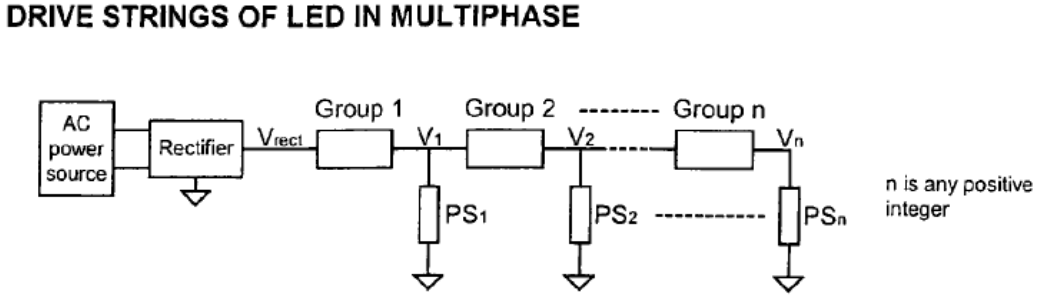


Figure 1 "shows a conceptual circuit of a multiphase LED driver of the present invention." *Id.* at 3:4–5. The Specification describes Figure 1 as depicting a power source electrically connected to a string of LEDs that are divided into "n" number of groups, wherein "n" represents a positive integer and reflects the number of the group, or phase, of the driver circuit. *Id.* at 3:20–25. Each phase switch ($PS_1$, $PS_2$ . . . $PS_n$) is electrically connected to a corresponding group at one end, and to the ground at the other end. *Id.* at 3:35–38. There are phase voltages ($V_1$, $V_2$ . . . $V_3$) at the joint points between the groups and the corresponding phase switches. *Id.* at 3:38–41. The Specification describes the phase switch as follows:

> The phase switch can be a current limited current sink, a switch, or a switch connected in series with resistor(s). The phase switch is a general term to indicate any device that, when turned on, conducts electrical current. Examples of the phase switch include, but not limited to, a N-Channel MOSFET, a P-Channel MOSFET, a NPN bipolar transistor, a PNP bipolar transistor, an Insulated Gate Bipolar Transistor (IGBT), an analog switch, a relay, etc. The "off" and "on" of each of the phase switch can be controlled individually.

*Id.* at 3:41–50.

The Specification describes the multiphase function of the driver circuitry as follows:

> The multiphase driver circuitry of the present invention can turn on/off each phase or each group of LEDs successively at a right power source voltage level. As the voltage of the power source increases enough to power the first LED group which is located immediately downstream the power source (Group 1 as shown in FIG. 1), first phase switch ($PS_1$ as shown in FIG. 1) conducts and the first LED group is turned on, while this level of voltage is not high enough to turn on the downstream LED groups, such as Group 2, Group 3, . . . and Group n as shown in FIG.1. Note that PS1 can be turned on before, at, or after the voltage of the power source reaches a level enough to power

> Group 1. The same applies to PS2, PS3, . . . and PSn. As the voltage of the power source further increases, it reaches a level enough to power the first and the second LED groups (Group 1 and Group 2), $PS_2$ conducts and the first and second LED groups are turned on. PS2 can be turned on before, at, or after the voltage of the power source reaches a level enough to power Group 1 and Group 2. As the increase in voltage of the power source continues, eventually all phases or LED groups are turned on in a sequence from upstream to downstream the string of LED groups.

*Id.* at 3:51–4:5. According to the Specification, the method and multiphase driver circuit of the invention provides the following advantages:

> 1. Work directly off-line. No magnetic, no energy storage capacitor, no AC/DC converter is needed.
> 2. Allow Power Factor Correction if desired.
> 3. Work with legacy dimmers
> 4. Allow new multiple dimming capability
> 5. Under-voltage protection: Natural under-voltage protection by turning on only the corresponding phases that has enough power to turn on. The result is slight dimming when under-voltage condition occurs.
> 6. Three different method for Over-voltage protections:
> constant light with high power dissipation, increasing light with redundant LED, or reducing light with lowest power dissipation.
> 7. Over temperature protection.
> 8. Use the power source period as the fundamental clock for various timing and flashing patterns.
> 9. Cost efficient implementation in an Integrated Circuit.

*Id.* at 6:38–54.

### *E. Illustrative Claims*

Petitioner challenges claims 1–3, 10–12, 15, 17–19, and 21 of the '722 patent. Claims 1 and 15, reproduced below, are the only independent claims and are illustrative of the claimed subject matter.

> 1. A method for driving light emitting diodes (LEDs) in multiphase, comprising:
> providing a string of LEDs divided into groups, said groups of LEDs being electrically connected to each other in series;
> providing a power source electrically connected to the string of LEDs;
> separately coupling each of the groups to a ground through separate conductive paths;
> providing a phase switch in each of the separate conductive paths;
> increasing an input voltage from the power source to turn on the LEDs, group by group in a sequence downstream the string.

Ex. 1001, 14:22–35.

> 15. A driver circuit for driving light emitting diodes (LEDs) in multiphase, comprising
> a string of LEDs divided into n groups, said n groups of LEDs being electrically connected to each other in series in a sequence from group 1 to group n, each group having an upstream end and a downstream end, and the downstream end of group m-1 being electrically connected to the upstream end of group m, where m is a positive integer equal to or less than n;
> a power source coupled to the upstream end of group 1 to provide an input voltage;
> a plurality of phase switches, each of the phase switches being coupled to the downstream end of a corresponding group at one end and coupled to a ground at the other end.

*Id.* at 15:30–16:4.

## II. PATENTABILITY ANALYSIS

### *A. Principles of Law*

To prevail in its challenges to the patentability of all claims of the '631 patent, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d)

(2019). "In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid. Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); *see also* 35 U.S.C. § 312(a)(3) (2012) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim"). That burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015); *see also In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1375–78 (Fed. Cir. 2016) (discussing the burden of proof in *inter partes* review).

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Schering Corp. v. Geneva Pharms*, 339 F.3d 1373, 1379 (Fed. Cir. 2003) (quoting *Verdegaal Bros., Inc. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987)).

A claim is unpatentable for obviousness if, to one of ordinary skill in the pertinent art, "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made." 35 U.S.C. § 103(a) (2006); *see also KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). "If a person of ordinary skill in the art can implement a predictable variation, § 103 likely bars its patentability." *Id.* at 417.

The question of obviousness is resolved on the basis of underlying factual determinations including the scope and content of the prior art, any differences between the claimed subject matter and the prior art, the level of

ordinary skill in the art, and objective evidence of nonobviousness.[6] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). "An obviousness determination requires finding both 'that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.'" *CRFD Research, Inc. v. Matal*, 876 F.3d 1330, 1340 (Fed. Cir. 2017) (quoting *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016)).

We analyze Petitioner's asserted grounds of unpatentability in accordance with the above-stated principles.

### *B. Person of Ordinary Skill in the Art*

The level of skill in the art is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *Al-Site Corp. v. VSI Int'l Inc.*, 174 F.3d 1308, 1323 (Fed. Cir. 1999) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966)); *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991)).

Petitioner asserts that a person of ordinary skill in the art ("POSITA") at the time of the invention would have had

> a bachelor's degree in electrical engineering or physics, plus three years of experience in circuit design and development related to lighting. Alternatively, a POSITA would have a master's degree in electrical engineering or physics, plus two years of experience in circuit design and development related to lighting . . . . A person with less education but more relevant practical experience, depending on the nature of that experience and degree of exposure to circuit design related to lighting could also qualify as a POSITA in the field of the '722 patent.

[6] The parties do not assert or rely on objective evidence of nonobviousness in this case.

Pet. 5–6 (citing Ex. 1003 ¶¶ 30–38; Ex. 1001, 1:6–14). In the Preliminary Response, Patent Owner did not address Petitioner's description of the level of ordinary skill in the art, or propose its own description.

At the institution stage, we preliminarily adopted Petitioner's definition. Inst. Dec. 8. Patent Owner did not address the level of ordinary skill in the art or provide its own description in its Response.

Accordingly, for this Decision we again adopt Petitioner's definition, again recognizing that this level of ordinary skill in the art is reflected in the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that specific findings regarding ordinary skill level are not required "where the prior art itself reflects an appropriate level and a need for testimony is not shown" (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp*., 755 F.2d 158, 163 (Fed. Cir. 1985))).

We have reviewed the credentials of Petitioner's declarant, Dr. Shackle, and Patent Owner's declarant, Dr. Zane, and consider each of them to be qualified to provide their opinion on the level of skill in the art and the knowledge of a person of ordinary skill in the art at the time of the invention. As discussed in the Consolidated Trial Practice Guide,

> An expert witness must be qualified as an expert by knowledge, skill, experience, training, or education to testify in the form of an opinion. Fed. R. Evid. 702. There is, however, no requirement of a perfect match between the expert's experience and the relevant field. *SEB S.A. v. Montgomery Ward & Co.*, 594 F.3d 1360, 1373 (Fed. Cir. 2010). A person may not need to be a person of ordinary skill in the art in order to testify as an expert under Rule 702, but rather must be "qualified in the pertinent art." *Sundance, Inc. v. DeMonte Fabricating Ltd.*, 550 F.3d 1356, 1363–64 (Fed. Cir. 2008).

Patent Trial and Appeal Board Consolidated Trial Practice Guide November 2019 ("CTPG") (available at https://www.uspto.gov/sites/default/files/documents/tpgnov.pdf), 34.

*C. Claim Construction*

Having defined the ordinarily skilled artisan, we now turn to claim construction. The Board applies the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 100(b) (2021). Under that standard, claim terms "are generally given their ordinary and customary meaning" as understood by a person of ordinary skill in the art at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). "In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence." *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

"[W]hile it is true that claims are to be interpreted in light of the specification . . . , it does not follow that limitations from the specification may be read into the claims. . . . It is the claims that measure the invention." *Sjolund v. Musland*, 847 F.2d 1573, 1581–82 (Fed. Cir. 1988) (emphasis omitted, citations omitted). Indeed, "when the specification describes the invention in broad terms, accompanied by specific examples or embodiments, the claims are generally not restricted to the specific examples or the preferred embodiments unless that scope was limited during prosecution." *Kinik Co. v. Int'l Trade Com'n*, 362 F.3d 1359, 1364 (Fed. Cir. 2004).

Petitioner proposes constructions for two claim terms: "phase switch" and "phase voltage." Pet. 6–8. In the Preliminary Response, Patent Owner disagreed with Petitioner and proposed its own constructions for those terms. Prelim. Resp. 4–23. At the institution stage, we preliminarily construed both terms. After institution, only one of those terms, i.e., "phase switch," remains in dispute. Additionally, Patent Owner proposes a claim construction for the term "dimming circuit," PO Resp. 25, which Petitioner challenges, Pet. Reply 3–5. Below, we provide constructions for three terms, "phase voltage," "phase switch," and "dimming circuit."

1. "phase voltage"

The term "phase voltage" appears in challenged claims 2 and 3, each of which depends from claim 1 and recites: "monitoring a phase voltage of each group." Ex. 1001, 14:37, 14:42. Claim 2 additionally recites: "turning off the phase switch of an upstream group, when the phase voltage of a next group downstream said upstream group reaches a predetermined value." *Id.* at 14:38–40. Claim 3 additionally recites: "turning off the phase switch of a group, when the phase voltage of said group reaches a predetermined value." *Id.* at 14:43–44.

Petitioner asserts that the term "phase voltage" refers to "the voltage at the downstream end of a group of LEDs (that is separately coupled through a phase switch to ground), i.e., the 'joint point' between the LED group and the next one." Pet. 8 (citing Ex. 1003 ¶¶ 28–31). Petitioner supports its proposed construction with the teaching in the '722 patent that the string of LEDs are divided into groups and "each of these groups of LEDs 'represents one phase' . . . [and] '[t]he voltages at the joint points between the groups . . . are phase voltage[s] and denoted by $V_1$, $V_2$, . . . $V_n$, respectively." *Id.* at 7 (citing Ex. 1001, 3:21–23, 3:26, 3:38–41). Petitioner

also refers to Figures 3–10 of the Specification for support. *Id.* at 7–8. As an example, Figure 10 of the '722 patent is set forth below.

Figure 10

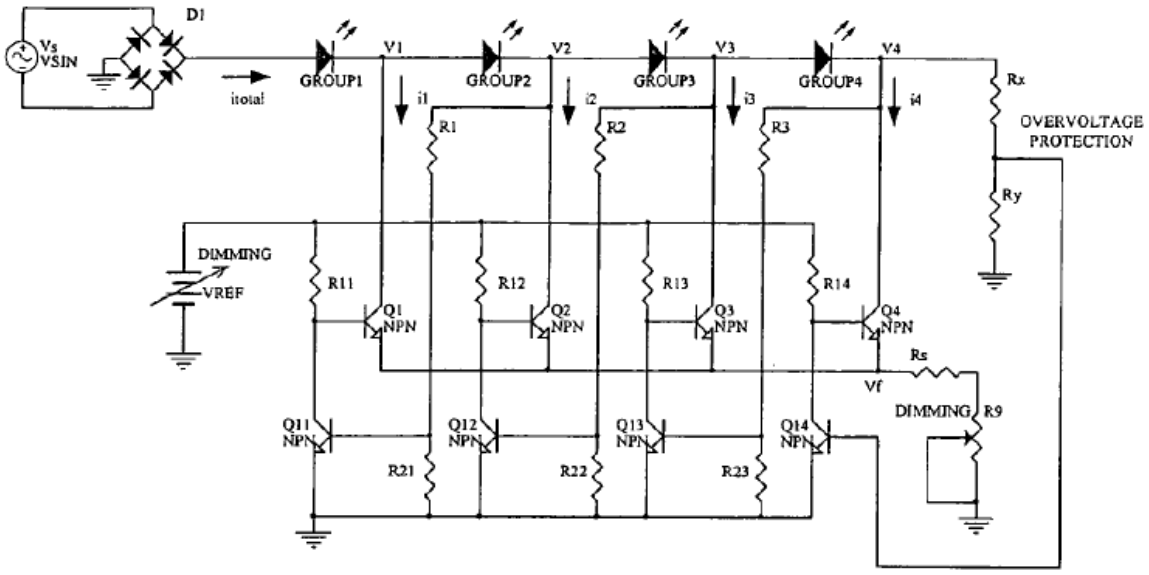



Figure 10 of the '722 patent "illustrates a four-phase LED driver circuit with active current control, dimming, and over-voltage protection." Ex. 1001, 2:36–38. Petitioner asserts that the figure shows the phase voltages are voltages "at the 'joint points' at the downstream ends of groups 1, 2 . . . and n,[] respectively." Pet. 7.

In the Preliminary Response, Patent Owner asserted that Petitioner's proposed construction "is incorrect, as the term 'phase voltage' is not limited to voltages at 'joint points' and also includes the voltage after the last LED group." Prelim. Resp. 23.

In the Institution Decision, we noted that both parties appear to have misapprehended the Specification's use of the term "joint points." Inst. Dec. 12. Petitioner referred to "the 'joint point' between the LED group and the next one." Pet. 8. Patent Owner asserted that there is no "joint point" after

the last LED group. Prelim. Resp. 23. We disagreed with both positions based on the description in the Specification that "[t]he voltages at the joint points between the groups and the corresponding phase switches are phase voltage and denoted by $V_1$, $V_2$, . . . $V_n$, respectively." Inst. Dec. 12–13 (quoting Ex. 1001, 3:38–41). We read that disclosure as describing the joint points as representing the joint or connection *between a group and its corresponding phase switch*, not merely a joint or connection between two groups. *Id.* at 13. In other words, a joint point is present in the string of LED groups where a corresponding phase switch is joined, whether between two groups or after the final group. *Id.* Thus, the voltages are "at the joint points." *Id.* (citing Ex. 1001, 3:38). As shown in Figure 10, the voltages denoted as V1, V2, V3, and V4 occur at the joint points between Groups 1–4 and their corresponding phase switch, and not merely between those groups, and the last joint point and voltage V4 does not occur between groups. *Id*.

Therefore, with a proper understanding of "joint points," we determined that the Specification provides a definition for the term "phase voltage" by stating that "[t]he voltages at the joint points between the groups and the corresponding phase switches are phase voltage and denoted by $V_1$, $V_2$, . . . $V_n$, respectively." Ex. 1001, 3:38–41. Thus, we preliminarily construed "phase voltage" in claims 2 and 3 consistent with that definition.

In the Patent Owner Response, Patent Owner asserts that it "does not take issue with the Board's construction of 'phase voltage' in the Institution Decision as it does not implicate any dispute here." PO Resp. 3. In the Reply, Petitioner also does not challenge the Board's preliminary determination. *See generally* Pet. Reply. Having considered the record as a whole, we see no reason to depart from our preliminary finding. Accordingly, we find that the Specification defines "phase voltage," i.e.,

"[t]he voltages at the joint points between the groups and the corresponding phase switches are phase voltage and denoted by $V_1$, $V_2$, . . . $V_n$, respectively," Ex. 1001, 3:38–41, wherein a "joint point" is present in the string of LED groups where a corresponding phase switch is joined, whether between two groups or after the final group.

2. "phase switch"

Independent claim 1 recites the term "phase switch" and independent claim 15 recites the term in the plural form, "phase switches." Ex. 1001, 14:31, 16:1. Petitioner asserts that the term "phase switch" means "'any device that, when turned on, conducts electrical current' such as, but not limited to, a P-Channel MOSFET." Pet. 7 (quoting Ex. 1001, 3:43–44). In support of its proposed construction, Petitioner asserts that the Specification defines this term in the following passage:

> The phase switch can be a current limited current sink, a switch, or a switch connected in series with resistor(s). ***The phase switch is a general term to indicate any device that, when turned on, conducts electrical current.*** Examples of the phase switch include, but not limited to, a N-Channel MOSFET, ***a P-Channel MOSFET***, a NPN bipolar transistor, a PNP bipolar transistor, an Insulated Gate Bipolar Transistor (IGBT), an analog switch, a relay, etc. The 'off' and 'on' of each of the phase switch can be controlled individually.

*Id.* at 6–7 (quoting Ex. 1001, 3:41–50).

In the Preliminary Response, Patent Owner disagreed with Petitioner's proposed construction and asserted that Petitioner's cited passage from the Specification "merely provides examples of switches." Prelim. Resp. 45. According to Patent Owner, the term "phase switch" should instead be construed more narrowly as "[a] device having on and off states that determines when to turn on to conduct electrical current." *Id.* at 4.

At the institution stage, we determined that the '722 patent Specification passage quoted by Petitioner defines the term "phase switch" broadly. Inst. Dec. 10 (citing Ex. 1001, 3:41–50). In particular, we found that Specification passage does not merely provide examples of a phase switch, but that it also expressly defines the claim term by stating, "[t]he phase switch is a general term to indicate any device that, when turned on, conducts electrical current." *Id.* (quoting Ex. 1001, 3:43–44) (alteration in original).

In the Patent Owner Response, Patent Owner challenges that finding and reiterates its position that "phase switch" should be construed as "a device having on and off states that determines when to turn on/off to conduct/stop conducting electrical current." PO Resp. 4. According to Patent Owner, "[a] person of ordinary skill in the art ('POSITA') would understand, in light of the specification, that the phase switch itself must also make the determination of when to turn itself (or its component switch) on or off." *Id.* Patent Owner asserts that recognizing the cited Specification passage as expressly defining the term "phase switch," as done in the Petition and the Board's Institution Decision, "impermissibly broaden[s] the claim by reading 'phase' out of the term, construing only 'switch.'" *Id.* at 4, 17–25.

Patent Owner contends that the claims support its proposed construction because "the claims require 'monitoring' both the 'phase voltage' and 'input voltage' and turning off a phase switch according to the result of that monitoring, i.e., determining when to turn a phase switch off." *Id.* at 4. Patent Owner asserts that the claims do not explicitly recite any structure to perform the monitoring step. According to Patent Owner, a skilled artisan would have understood that there must be associated circuitry

to turn off the phase switch as a result of monitoring the phase voltage. *Id.* at 5. In view of that understanding, Patent Owner asserts that the skilled artisan would have recognized that the Specification "discloses that the phase switch itself performs this monitoring." *Id*. (citing Ex. 2007 ¶¶ 48–49).

In that regard, Patent Owner asserts that the Specification supports its proposed construction because "[e]very embodiment of a 'phase switch' in the '722 Patent includes the means to perform the required determining when to conduct or not conduct, whether with an Op-Amp in Figures 3-7, or with an NPN bipolar transistor in Figures 8-12." *Id.* at 6–7 (citing Ex. 1001, 6:62–71, 8:58–66, 10:4–7, 10:20–22, 10:34–36, 11:41–50, 12:8–9, 12:34–36; Ex. 2007 ¶¶ 28–43).

For example, Patent Owner emphasizes the embodiments of Figures 5 and 6 in the Specification to illustrate that "the phase switch includes the means for monitoring voltage to determine when to turn on/off." *Id.* at 7. In support of that contention, Patent Owner refers to the following passage in the Specification:

> **[E]ach PS [phase switch] in this circuit [FIG. 6] monitors its own phase voltage to determine when to turn itself off while each PS in the circuit in FIG. 5 monitors the down stream phase voltage to turn itself off.** It is possible for the PS to monitors both its own phase voltage and the down stream phase voltage to determine the best turn off moment. Such variation is included in this embodiment.

*Id.* at 7 (quoting Ex. 1001, 10:13–18) (emphasis added by Patent Owner, alterations in original); Ex. 1001, 10:18–19. When citing that passage relating to Figure 6, Patent Owner also directs us to the Specification description for Figure 10, which states that "[e]ach phase switch can sense its own phase voltage to determine when to turn itself off." PO Resp.

(quoting Ex. 1001, 12:3–4). According to Patent Owner, a skilled artisan would have understood that "a 'phase switch' is a switch that is in control of its corresponding phase, and as such, it controls when it turns on and off." *Id.* at 7–8 (citing Ex. 2007 ¶¶ 30, 46–51).

In the Reply, Petitioner reiterates its position that the '722 patent defines "phase switch" as "any device that, when turned on conducts electrical current." Pet. Reply 1. Petitioner asserts that the phase switches exemplified with that definition "turn LED phases on/off—each LED 'group'/'phase' has a corresponding switch." *Id.*

Petitioner contends also that Patent Owner's proposed construction should be rejected because it "asks the Board to import an additional requirement that the phase switch 'determine[]' whether to turn itself on/off," which would "violate[] fundamental cannons of claim construction by attempting to import into the independent claims features that are allegedly found in dependent claims and the specification." *Id.* at 1–2 (first alteration in original).

Additionally, Petitioner asserts that Patent Owner's proposed construction is "improperly narrow because it diverges from the patent's own definition and its examples." *Id.* at 3. In particular, Petitioner contends that Patent Owner's reliance on certain embodiments in the Specification "ignores the patent's non-limiting list of phase switches, which includes transistors, relays, and analog switches." *Id.* at 2 (citing Ex. 1001, 3:41–50). According to Petitioner, "[t]hese components turn on/off based on external excitation . . . without 'determining' anything in isolation." *Id.* For example, Petitioner asserts that a "relay" conducts current when a separate current is passed through a control winding, and an analog switch turns on/off, e.g., when a person flips the switch. *Id.* at 3. Similarly, Petitioner

contends that a transistor, alone, does not have a means for determining when to conduct or not conduct. *Id.* at 2. Petitioner notes that a number of the embodiments relied upon by Patent Owner utilize NPN transistors. *Id.* (citing PO Resp. 6–10). According to Petitioner, Patent Owner admits "to perform the 'determining,' the phase switch requires 'an NPN transistor *and* a resistor network,'" as depicted in Figures 8 and 10–12. *Id.* at 2–3 (citing PO Resp. 12–13) (emphasis added). Petitioner asserts that the phase switches in Figure 9, however, "consist only of individual transistors, which conduct current based on circuit conditions, without 'determining' anything." *Id.* at 3 (citing Ex. 1040, 39:8–14, 40:8–47:23) (Zane deposition). Based on that example, Petitioner asserts that the Specification does not support narrowing the definition of "phase switch" as Patent Owner argues. *Id.* at 2–3.

In its Sur-reply, Patent Owner begins by asserting that Petitioner relies on lexicography for its proposed construction of the term "phase switch" without demonstrating the required "'exacting' standards with a 'clearly set forth [] definition' and a 'clearly express[ed] intent to define the term." PO Sur-reply 1 (quoting *Hill-Rom Servs., Inc. v. Stryker Corp.*, 755 F.3d 1367, 1371 (Fed. Cir. 2014)) (alterations in original). Patent Owner asserts also that even if the Specification description of "phase switch" is considered to be "definitional, it is only a partial definition that sets forth an open-ended list of potential switch structures." *Id.* (emphasis omitted).

According to Patent Owner, a person of ordinary skill in the art would have recognized that description is incomplete, as "it says nothing about the 'phase.'" *Id.* Patent Owner asserts again that the skilled artisan would have understood from the Specification that the phase switch "must determine when to turn itself on or off so that it controls its phase." *Id.* at 1–2. Patent

Owner asserts also that its proposed construction is based on an implicit definition in the Specification because "every disclosed embodiment shows that phase switches determine when to turn on and off." *Id.* at 2. To that point, Patent Owner asserts that Petitioner's argument to the contrary mischaracterizes Patent Owner's position. *Id.* at 4. Patent Owner explains that, in the Response, it asserts that "Figures 8 and 9 use only an NPN transistor and a resistor network for the phase switch, **with the transistor accomplishing the functions of both the FET and the Op Amp**." *Id.* (quoting PO Resp. 12–13). Patent Owner refers also to the Specification description that "FIG. 8 shows a circuit using the same principle of the circuit in FIG. 3, but the Op-Amp function is designed using NPN bipolar transistors (Q)." *Id.* at 3 (quoting Ex. 1001, 10:34–37) (emphasis omitted). According to Patent Owner, "[t]he 'Op-Amp function' is the on/off determination done by the NPN transistors in a particular configuration." *Id.* at 3–4 (citing PO Resp. 6–12).

We have considered the evidence and the arguments raised by both parties. Based on the record, as a whole, we determine that Petitioner's position is better supported. As explained by the Federal Circuit, in a case relied upon by Petitioner, "[w]hen a patentee explicitly defines a claim term in the patent specification, the patentee's definition controls." *Martek Biosciences v. Nutrinova*, 579 F.3d 1363, 1380 (Fed. Cir. 2009). Here, Figure 1, reproduced above in Section I.D., illustrates a conceptual circuit of a multiphase LED driver of the invention. Ex. 1001, Fig. 1, 3:4–5. Referring to that figure, the Specification describes elements of the driver circuit. For the phase switches, the Specification states,

> There [are] provided phase switches $PS_1$, $PS_2$ . . . $PS_n$, in the LED driver circuit. Each of the phase switches is electrically

> connected to a corresponding group at one end and to the ground at the other end. The voltages at the joint points between the groups and the corresponding phase switches are phase voltage and denoted by $V_1$, $V_2$, . . . $V_n$, respectively. The phase switch can be a current limited current sink, a switch, or a switch connected in series with resistor(s). The phase switch is a general term to indicate any device that, when turned on, conducts electrical current. Examples of the phase switch include, but not limited to, a N-Channel MOSFET, a P-Channel MOSFET, a NPN bipolar transistor, a PNP bipolar transistor, an Insulated Gate Bipolar Transistor (IGBT), an analog switch, a relay, etc. The "off" and "on" of each of the phase switch can be controlled individually.

*Id.* at 3:35–50. We find that passage contains an explicit definition for the term phase switch, i.e., "The phase switch is a general term to indicate *any device* that, when turned on, conducts electrical current." *Id.* at 3:43–44 (emphasis added). Further, by characterizing "[t]he phase switch" as a "*general term* to indicate *any* device that, when turned on, conducts electrical current," we find that the Specification deliberately defines the phase switch broadly to encompass "any" such device. *Id.* (emphases added).

Consistent with that broad definition of "[t]he phase switch," the Specification thereafter discloses exemplary devices that are considered to be phase switches for purposes of the invention, by stating "[e]xamples of *the phase switch* include, but [are] *not limited to*, a N-Channel MOSFET, a P-Channel MOSFET, a NPN bipolar transistor, a PNP bipolar transistor, an Insulated Gate Bipolar Transistor (IGBT), an analog switch, a relay, *etc.*" *Id.* at 3:45–48 (emphases added). We understand the Specification to be indicating examples of phase switches for purposes of the disclosed LED driver circuit. Further, the Specification explicitly states that the examples

are non-limiting and indicates that the listing is open-ended by ending the list with "etc."

We disagree with Patent Owner's assertion that recognizing the above-quoted Specification passage as expressly defining the term phase switch "impermissibly broaden[s] the claim by reading 'phase out of the term, construing only 'switch.'" PO Resp. 4, 17–25. First, we have not construed only the term "switch," but have determined instead that the Specification itself defines "phase switch." Further, the term "phase switch" itself provides its context, i.e., it is a switch for a phase. It is apparent that the term phase is used as a denominal adjective, i.e., an adjective derived from the noun "phase." As such, the term "phase" modifies the term "switch." Thus, when the Specification explicitly defines "the phase switch," we find that a person of ordinary skill in the art would have understood that it refers not to any switch, but to a switch for a phase.[7]

We acknowledge Patent Owner's contention that "phase switch" should be construed as "a device having on and off states that determines when to turn on/off to conduct/stop conducting electrical current." PO Resp. 4. However, we find that Patent Owner has not demonstrated persuasively that we should so limit the definition set forth in the Specification. In particular, we agree with Petitioner that Patent Owner's proposed construction involves importing an element of the dependent claims into the independent claim. Specifically, Patent Owner asserts that "the claims

[7] We note that the Specification explains that the "string of LEDs is divided into groups," wherein "[o]ne group represents one phase of the string," and "[a] phase switch is provided for each group." *Id.* at 1:9–12, 42–43, 51–52. In other words, as the parties have acknowledged, a "phase" refers to a "group." *See, e.g.*, PO Resp. 23, Pet. Reply 1.

require 'monitoring' both the 'phase voltage' and 'input voltage' and turning off a phase switch according to the result of that monitoring, i.e., determining when to turn a phase switch off." *Id.* However, the method of independent claim 1 does not recite a monitoring step. Rather, only certain dependent claims recite "monitoring a phase voltage" or "monitoring an input voltage." *See, e.g.*, dependent claims 2 and 4. Petitioner correctly refers to *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 910 (Fed. Cir. 2004) in this regard: "As this court has frequently stated, the presence of a dependent claim that adds a particular limitation raises a presumption that the limitation in question is not found in the independent claim." *Id.* Patent Owner has not demonstrated, nor do we find, circumstances present in this case that would rebut that presumption.

Further, the dependent claims reciting a monitoring step do not require the phase switch to perform such monitoring. Indeed, as acknowledged by Patent Owner, those claims do not recite what the means for the monitoring step is. And we decline to supply or otherwise limit such means based upon the Specification disclosure of preferred embodiments or Patent Owner's discussion of them. At most, that discussion exemplifies the breadth of the phase switch, in that it *may* comprise additional components or attributes, such as specific embodiments wherein the "phase switch can sense its own phase voltage to determine when to turn itself off." Ex. 1001, 12:3–5 (describing a characteristic of the phase switch in the embodiment illustrated in Figure 9). As the Federal Circuit has explained, "when the specification describes the invention in broad terms, accompanied by specific examples or embodiments, the claims are generally not restricted to the specific examples or the preferred embodiments unless that scope was limited during prosecution." *Kinik*, 362 F.3d at 1365. We do not see that

Patent Owner has established, on this record, any such limitation of the scope of the monitoring means during prosecution.

Accordingly, based on the record as a whole, we find that the Specification defines "the phase switch" broadly as "a general term to indicate *any device* that, when turned on, conducts electrical current." Ex. 1001, 3:43–44. Further, we find that Patent Owner has not persuasively demonstrated that we should construe that term to narrow the explicit definition set forth in the Specification because the claims do not expressly require the phase switch to perform any monitoring or determining step, and Patent Owner points to no clear disavowal of claim scope in the Specification or the prosecution history.

3. "dimming circuit"

Challenged claim 21 recites, "The driver circuit of claim 15, further comprising a dimming circuit." Ex. 1001, 16:22–23. Petitioner did not propose a construction for the term "dimming circuit" in the Petition, and we did not provide a preliminary construction for this term in the Institution Decision, as it was not in dispute at that stage of the proceeding.

In the Patent Owner Response, Patent Owner proposes that we construe the term "dimming circuit" to mean "a circuit, separate and distinct from the phase switches, that provides a dimming effect." PO Resp. 25. Patent Owner asserts that, as claimed, the phase switches are a component of the driver circuit of claim 15, and the "'dimming circuit' is an additional required component of the 'driver circuit' and a separate element from the 'phase switches,' and is presumptively a physically distinct component." *Id.* at 26. According to Patent Owner and Dr. Zane, a person of ordinary skill in the art would have understood that "the 'phase switches' and the 'dimming circuit' cannot be physically coextensive." *Id.* (citing Ex. 2007 ¶¶ 55–56).

Patent Owner asserts also that the Specification's disclosure of the dimming circuit in Figures 3–4, 6–10, and 12 supports its proposed construction. *Id.* at 26–32. According to Patent Owner, the Specification discloses "two kinds of circuits for dimming LEDs: circuits that adjust the phase current limit level set in each phase switch, and circuits that adjust the voltage at which the phase switches turn themselves on and off. *Id.* at 26–27 (citing Ex. 1001, 5:48–53, 4:27–31; Ex. 2003, 139:5–140:8 (Shackle Deposition)). Patent Owner contends that, although the circuitry adjusts the appropriate parameters of the phase switches according to one of those methods, the "dimming circuitry is separate and distinct from the phase switches." *Id.* at 27.

Petitioner disagrees with Patent Owner and asserts that the Specification "describes circuitry that creates a 'dimming effect' by simply turning off LED groups." Pet. Reply 3–4 (citing Ex. 1001, 4:27–31, 5:26–27, 5:48–56, 8:46–52). According to Petitioner, because the phase switches are part of that on/off circuitry, the phase switches need not be "separate and distinct" from the dimming circuit. *Id.* at 4. Petitioner asserts that Patent Owner's expert, Dr. Zane, agreed to that point when he testified that "R9 is a variable resistor, [which] provides the dimming function for what we've described as dimming circuit 2. It operates in conjunction with the remaining sense resistors and the phase switches and the other circuitry." *Id.* (quoting Ex. 1040, 28:11–37:17).

Petitioner also challenges Patent Owner's contention that there is a "presumption that separate claim elements claim *physically* separate and distinct components." *Id.* at 4 (quoting PO Resp. 25). Petitioner counters that contention by referring to case law and a Board decision recognizing that "[t]he use of two terms in a claim requires that they connote different

meanings, not that they necessarily refer to two different structures." *Id.* (quoting *Applied Med. Res. Corp. v. U.S. Surgical Corp.*, 448 F.3d 1324, 1333 n.3 (Fed. Cir. 2006)) (emphasis omitted). Petitioner asserts that "claim 21 merely lists 'a dimming circuit' that must be part of the 'driver circuit,'" not that it needs to be "separate and distinct" from other elements of the driver circuit. *Id.* at 5.

In its Sur-reply, Patent Owner clarifies that its position is that the phase switch and dimming circuit "cannot be **coextensive**, not that the component must be completely different." PO Sur-reply 5. Patent Owner asserts that Petitioner's position is that "the two claim elements can be coextensive with one another," which "equates the 'phase switch' with the 'dimming circuit.'" *Id.* (citing Pet. 44, 61–62). Patent Owner contends that Petitioner acknowledges that the phase switches in the '722 patent are "only 'part of' the 'on/off circuitry' that 'creates a dimming effect.'" *Id.* at 6 (citing Pet. Reply 3–4). Patent Owner asserts that "altering the 'turn on/turn off' functionality of the phase switches requires separate circuitry – i.e., the 'dimming circuit.'" *Id.* In other words, Patent Owner asserts that "[t]he dimming circuit . . . is a structure that includes at least some circuitry separate from the phase switches that alters their normal functioning." *Id.* (emphasis omitted). According to Patent Owner, Petitioner's admission that the phase switches are only part of the on/off circuitry that creates a dimming effect is "fatal to its argument, as it reads what it identifies as the 'phase switch' onto the 'dimming circuit' with no additional circuitry." *Id.*

Having considered the evidence and the arguments raised by both parties, we find that the Specification does not support construing the dimming circuit narrowly to mean "a circuit, separate and distinct from the phase switches, that provides a dimming effect," as Patent Owner originally

proposed. PO Resp. 25. As both parties have acknowledged, the phase switches are part of the on/off circuitry that creates a dimming effect. *See* Pet. Reply 4; PO Sur-reply 6. Thus, as Petitioner asserts, the phase switches do not need to be "separate and distinct" from the dimming circuit.

Insofar as Patent Owner clarifies that it proposes a construction wherein the dimming circuit means a circuit that is not coextensive with the phase switch, we remain unpersuaded. As we discussed in our analysis of the term "phase switch," that term is defined by the Specification broadly.

Furthermore, the Specification discloses a number of methods to create a dimming effect. *See, e.g.*, Ex. 1001, 5:44–56. For example, the Specification states that the "LEDs can be dimmed by adjusting the phase current limit level set in each phase switch (PS). The LEDs can also be dimmed by turning on each group late, by turning off each group early, or by turning one or more groups off." *Id.* at 5:47–52.

Patent Owner has not persuasively demonstrated that we should construe dimming circuitry in a manner that excludes it from being coextensive with the phase switch because the claims do not expressly require the two claim elements to be entirely distinct from one another, and Patent Owner does not point to any such limitation in the Specification. Insofar as Patent Owner argues that the Specification's disclosure of the dimming circuit in Figures 3–4, 6–10, and 12 supports its proposed construction, *see* PO Resp. 26–32, we remain unpersuaded as that argument seeks to limit the broadly recited "dimming circuit" in claim 21 based on exemplary embodiments in the Specification, without demonstrating any clear disavowal of claim scope in the Specification or the prosecution history.

Thus, we agree with Petitioner that claim 21 merely recites "'a dimming circuit' that must be part of the 'driver circuit,'" without requiring it to be completely distinct from the phase switch or other elements of the driver circuit. Pet. Reply 5. Accordingly, we decline to adopt Patent Owner's proposed construction that limits the dimming circuit to "a circuit, separate and distinct from the phase switches, that provides a dimming effect." *See* PO Resp. 25. Instead, we recognize the ordinary and customary meaning for the "dimming circuit," i.e., any circuit comprised in the driver circuit that is capable of providing a dimming effect.

### *D. Anticipation and Obviousness based upon Chiang*

Petitioner asserts that claims 1–3, 10, 15, 19, and 21 are anticipated by Chiang. Pet. 20–44; Pet. Reply 6–19. Petitioner asserts also that those claims are rendered obvious over Chiang. Pet. 20–44. Patent Owner disagrees with both challenges. PO Resp. 33–52; PO Sur-reply 6–14.

#### *1. Chiang*

Chiang describes "an LED driving device in which the LEDs can be driven by the positive part of power source directly." Ex. 1004 ¶ 15. Chiang explains that the LED driving device is "capable of improving the power factor and efficiency." *Id.* ¶ 2. Figure 5A of Chiang is set forth below.

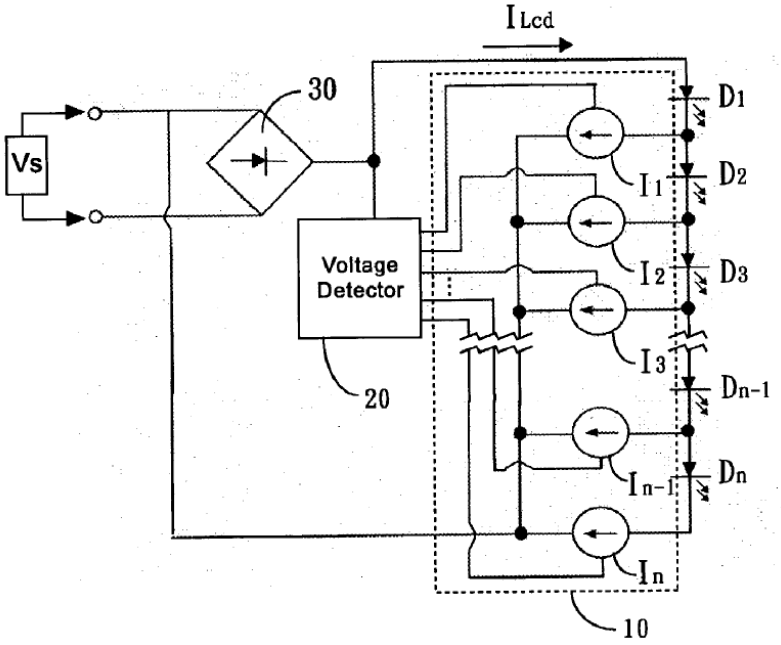



FIG. 5A

Chiang's Figure 5A is a circuit diagram of an LED driving device. *Id.* ¶ 33. The circuit comprises an LED string, a voltage detecting circuit 20, and a current switching circuit 10. *Id.* Figure 5A also depicts power source Vs that "can be any kind of input voltage source" and bridge rectifier circuit 30 that "can be used to convert the negative part of the power source Vs" thereby increasing the lighting time of the LEDs. *Id.* ¶¶ 33, 36. The voltage detecting circuit 20 detects the voltage level of the power source and the "current switching circuit 10 including grounded current controlling unit $I_1$, $I_2$, $I_3$, . . ., $I_{(n-1)}$, and $I_n$." *Id.* ¶ 33. The LED string is connected in parallel across the power source and is composed of "series connected LED sets D1, D2, D3, . . . Dn-1, and Dn." *Id.* ¶ 34. When the voltage detecting circuit detects the voltage level of the power source, it sends a signal to the current switching circuit, which electrically rearranges the configuration of LEDs by turning on/off current controlling units $I_1$, $I_2$, $I_3$, . . . $I_{(n-1)}$, $I_n$ based on the detected voltage, in order to drive selected LED sets D1, D2, D3, . . . Dn-1,

and Dn. *Id.* ¶ 35; *see also* Ex. 1003 ¶ 43 (Dr. Shackle's summary of Chiang).

Chiang describes a scenario in which only current controlling unit I1 is enabled and "the current path is power source Vs, LED set D1, and current controlling I1, and ground," and when the voltage of the power source increases, then current controlling unit I1 is disabled, only current controlling unit I2 is enabled, and "the new current path is power source Vs, LED set D1, LED set D2, and current controlling unit I2, and ground." Ex. 1004 ¶ 38.

Figure 2A of Chiang is set forth below.

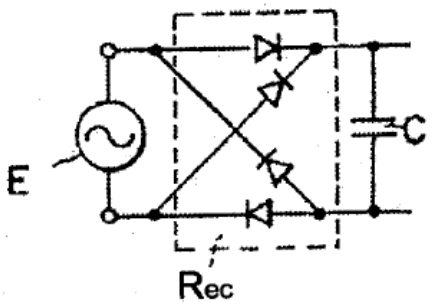



FIG. 2A

Chiang's Figure 2A is a circuit diagram of a bridge rectifier. *Id.* ¶ 10. Chiang explains by way of background that, if an AC power source is used to energize an LED, light will be emitted only during the positive part of the AC power source and that a bridge rectifier can be coupled to the AC power source to convert the negative part of the AC power source to the positive part. *Id.*

*2. Discussion*

For each of its challenges, Petitioner refers to a modified version of Chiang's Figure 5A, set forth below:

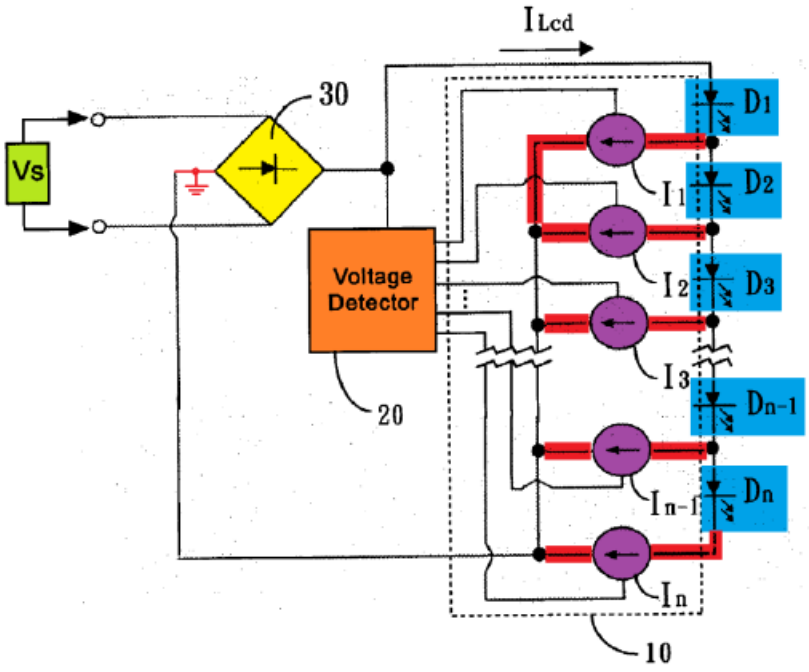
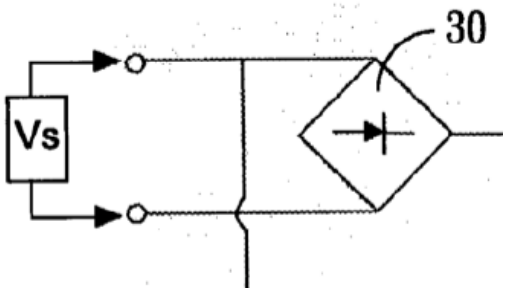



FIG. 5A

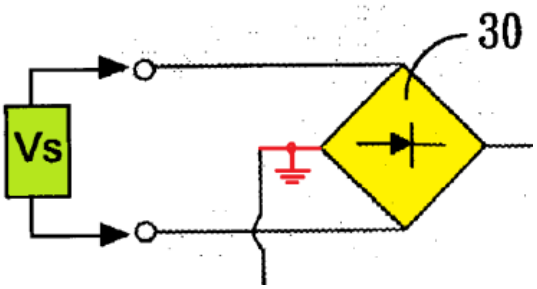
Pet. 21. Petitioner's modified version of Chiang's Figure 5A includes three types of modifications. First, Petitioner highlights, in different colors, components of Chiang's circuit diagram. *Id.* at 21–29. In particular, Petitioner asserts that Chiang's circuit includes: (a) series connected LED sets $D_1$, $D_2$, $D_3$, . . . , $D_{n-1}$, and $D_n$, highlighted in blue; (b) a power source Vs, highlighted in green, electrically connected to the string of LEDs through bridge rectifier 30, highlighted in yellow; and (c) a separate conductive path to ground, highlighted in red, for each LED set through grounded current controlling units $I_1$, $I_2$, $I_3$, . . ., $I_{(n-1)}$, and $I_n$; wherein (d) the grounded current controlling units $I_1$, $I_2$, $I_3$, . . ., $I_{(n-1)}$, and $I_n$, highlighted in purple, each represent a phase switch in each of the separate conductive paths. *Id.* at 21–25.

Second, Petitioner's modified version of Chiang's Figure 5A redraws the connection from the current controlling units to the power input source

so that the connection leads to the bridge rectifier instead of the power input source. *Id.* at 10. Third, Petitioner adds a ground in that redirected connection pathway from the current controlling units to the bridge rectifier. *Id.* Petitioner's second and third modifications are illustrated by the following side-by-side comparison of the relevant portions of Chiang Figure 5A and Petitioner's modified version of that figure:




**Chiang Figure 5A (excerpt)**

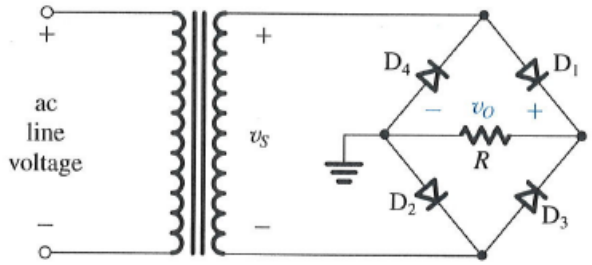



**Petitioner's modification (excerpt)**

The above figures show a portion of a circuit diagram for an LED driving device.

According to Petitioner and its declarant, Dr. Shackle, those modifications correct a "drafting error that would be immediately apparent to a POSITA, in which the ground wire from the current controlling units (I1 to In) is connected back to the input source (Vs)." Pet. 10 (citing Ex. 1003 ¶¶ 43–44). Petitioner asserts that "[a] POSITA would know that the ground wire should instead be connected to the other side of the rectifier (30) (yellow) and to ground, as shown in red [in Petitioner's modified version of Chiang's Figure 5A]." *Id.* To support its addition of the ground to Chiang's Figure 5A, Petitioner refers to Chiang's disclosures that: (a) "said current switching circuit 10 includ[es] grounded current controlling unit $I_1$, $I_2$, $I_3$, . . ., $I_{(n-1)}$;" (b) in one aspect, the circuit "current path is power source Vs, LED set $D_1$, and current controlling unit $I_1$, and ground;" and (c) with increased voltage "[t]he new current path is power source Vs, LED set $D_1$, LED set $D_2$,

and current controlling unit $I_2$, and ground." *Id.* at 10–11 (quoting Ex. 1004 ¶¶ 33, 38) (Petitioner's emphasis omitted). Petitioner asserts that a skilled artisan would have understood that the ground wire from the current controlling units should be connected to the bridge rectifier "because that is how a bridge rectifier is normally designed." *Id.* at 11. In support of that assertion, Petitioner and Dr. Shackle refer to Figure 3.39(a) in Sedra,[8] set forth below. *Id.* at 12.




(a)

Sedra explains that Figure 3.39(a) shows a bridge rectifier circuit that is "[a]n alternative implementation of the full-wave rectifier" shown in an earlier figure in Sedra, i.e., Figure 3.38. Ex. 1009, 184.

*a) Claim 15*

As set forth above in Section I.D., independent claim 15 is directed to a driver circuit for driving LEDs in multiphase. Petitioner has identified the disclosures in Chiang that Petitioner asserts correspond to each element of claim 15. *See* Pet. 37–41. Based upon our review and consideration of the complete record, we determine that Petitioner has established by a preponderance of the evidence that claim 15 is anticipated by Chiang. In particular, we find that Petitioner has shown persuasively that Chiang

[8] Sedra et al., *Microelectronic Circuits*, 4th ed. New York: Oxford University Press 1998 ("Sedra," Ex. 1009).

discloses a driver circuit for driving LEDs in multiphase comprising each element recited by claim 15, as expressly set forth in Chiang's Figure 5A, its discussion of the circuit path, and its description of phase switches, in view of our claim construction of that term.

Specifically, Petitioner refers to highlighted portions of its modified version of Chiang's Figure 5A to demonstrate that Chiang discloses the elements of claim 15, including:

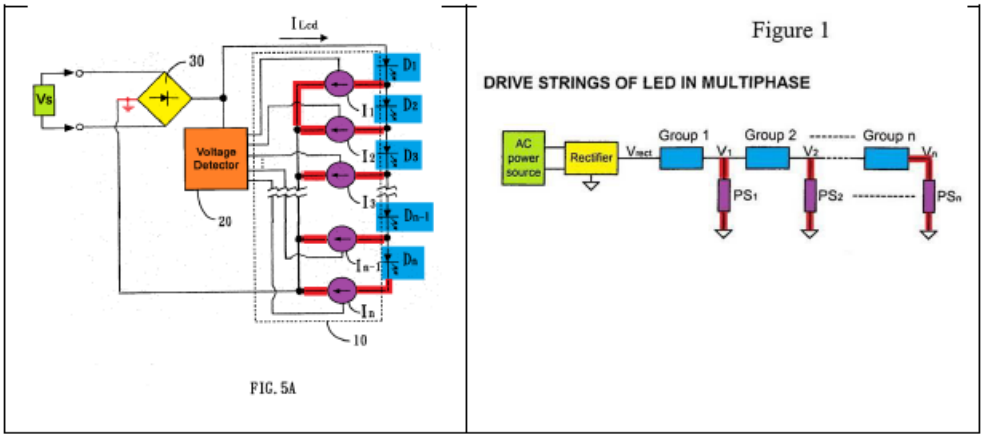
(1) a string of LEDs divided into n groups of LEDs electrically connected to each other in series in a sequence from group 1 to group n, each group having an upstream end and a downstream end (element [15a]), and the downstream end of one group is electrically connected to the upstream end of the following group (element [15a]), i.e., Chiang's LED sets $D_1$, $D_2$, $D_3$, ..., $D_{n-1}$ (highlighted blue);

(2) a power source coupled to the upstream end of group 1 to provide an input voltage (element [15[c]), i.e., Chiang's power source Vs (highlighted green) electrically coupled through the rectifier (yellow) to the $D_1$ LED group (highlighted blue); and

(3) a plurality of phase switches, each of which is coupled to the downstream end of a corresponding group at one end and coupled to a ground at the other end (element [15d]), i.e., Chiang's current controlling units $I_1$, $I_2$, $I_3$, . . ., $I_{(n-1)}$, and $I_n$ (highlighted purple). *Id.* at 37–40.

Petitioner asserts that "[t]he current controlling units $I_1$, $I_2$, $I_3$, . . ., $I_{(n-1)}$, and $I_n$ of Chiang are phase switches because they can be turned on or off, and, when turned on, they conduct electrical current to ground from their corresponding LED set[.]" *Id.* at 39–40 (incorporating *id.* at 23–24 (citing Ex. 1004 ¶ 38)). Additionally, Petitioner asserts that Chiang discloses that its current controlling units may be transistors, a recognized example in the

'722 patent of a phase switch. *Id.* at 25–26 (citing Ex. 1001, 3:41–48; Ex. 1004, claim 5). Further, Petitioner asserts that the phase switch in the '722 patent is depicted in each of the separate conductive paths in the same way as shown in Chiang Figure 5A. Petitioner's side-by-side comparison of its modified versions of Chiang's Figure 5A and the '722 patent's Figure 1 is set forth below:




(Ex-1004-Chiang at FIG. 5A; Ex-1001 at FIG. 1.)

The above figures show LED driving circuits. Petitioner's modified version of the '722 patent's Figure 1 highlights in different colors the components of the '722 patent's driver circuit depicted in the figure. Pet. 26. Petitioner color codes that highlighting to correspond with the color coding used for its modified version of Chiang's Figure 5A, i.e., phase switches highlighted in purple and the separate conductive paths highlighted in red. *Id.*

For the limitation requiring that the phase switches are coupled to a ground at the other end, Petitioner refers to Chiang's teachings that "current switching circuit 10 include[s] grounded current controlling unit I1, I2, I3, …, I(n−1), and In" and "[t]he current path is power source Vs, ***LED set $D_1$, and current controlling unit $I_1$, and ground***. ... The new current path is power source Vs, LED set $D_1$, ***LED set $D_2$, and current controlling unit $I_2$, and ground***." *Id.* at 23–24 (discussing claim element [1c] and quoting Ex.

1004 ¶¶ 33, 38); *id.* at 39–40 (referring to discussion of claim element [1c]). Additionally, Petitioner again refers to its side-by-side comparison of its modified versions of Chiang's Figure 5A and the '722 patent's Figure 1 to assert that "the LED driver circuit disclosed in Chiang is virtually identical to that shown in FIG. 1 of the '722 patent." *Id.* at 40.

In reaching our determination, we considered Patent Owner's arguments and evidence. Patent Owner's only argument regarding claim 15 is that Petitioner has failed to establish that Chiang's current controlling units ("CCUs") are "phase switches." PO Resp. 35–40. To support that argument, Patent Owner relies on its proposed construction of "phase switch" which would require the phase switch to be "a device having on and off states that determines when to turn on/off to conduct/stop conducting electrical current." *See id.* at 4. According to Patent Owner, Chiang's CCUs are not phase switches because they do not determine when to turn themselves on and off. *Id.* at 36, 39–40.

Patent Owner's argument is not persuasive as we have not adopted its proposed construction for "phase switch." Rather, as discussed above, we have found that the Specification broadly defines the term without requiring the device to determine when to turn itself on or off. As defined in the Specification, "The phase switch is a general term to indicate *any device* that, when turned on, conducts electrical current." Ex. 1001, 3:43–44 (emphasis added). There is no dispute between the parties that Chiang's CCUs are devices that, when turned on, conduct electrical current. Accordingly, we find that Petitioner has shown by a preponderance of the evidence that Chiang's CCUs are a "plurality of phase switches."

Patent Owner does not challenge Petitioner's showing regarding the remaining limitations of claim 15. *See generally* PO Resp. As discussed

above, we find that Petitioner has persuasively demonstrated that Chiang discloses each limitation of the claim. Accordingly, we determine that Petitioner has shown that Chiang anticipates claim 15. Petitioner also alleges that Chiang renders obvious claim 15. Because we have determined that Chiang anticipates the claim, we need not reach the obviousness challenge here.

*b) Claim 19*

Claim 19 depends from claim 15 and further requires that "the phase switch of group n is capable of tolerating a relatively larger power than that of groups 1 to n-1." Ex. 1001, 16:16–18. Referring to Chiang Figure 6, set forth below, Petitioner asserts that Chiang discloses this limitation. Pet. 41.

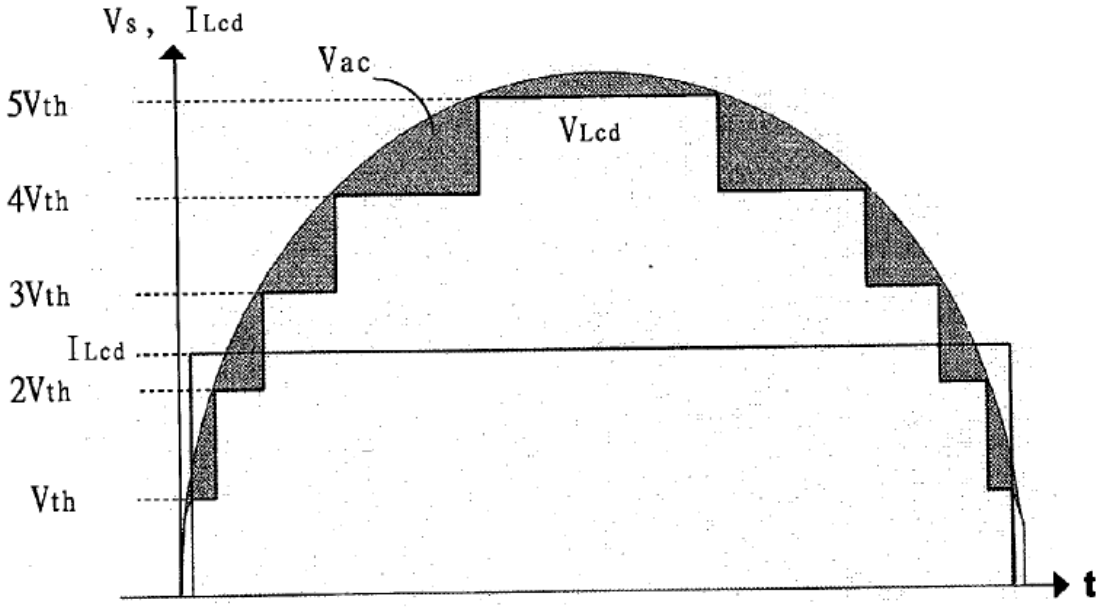



FIG. 6

Chiang's Figure 6 "is a waveform diagram of power source voltage, current and drop voltage on a LED when supplied by an AC power source." Ex. 1004 ¶ 31. Chiang further describes the figure as follows:

> There are five LED sets for this diagram. Regardless of the power loss due to stray resistors and capacitors, because there is no capacitor in the present invention, the output power for the power source is the product of the voltage area of power source and $I_{Led}$. The voltage across all the energized LED is a step shape and the power is the product of area of the step shape and $I_{Led}$. The difference between these two powers is the power loss andthe power loss is equal to the area of the shadow. *The difference in voltage between the power source and the across voltage of total energized LEDs will drop on the current controlling unit.*

*Id.* ¶ 42 (emphasis added). Based on that disclosure, Petitioner asserts that "Chiang explains that the power dissipation of each phase switch current limiter is proportional to the shadowed (i.e., shaded) area of [Figure] 6." Pet. 41.

Petitioner contends and Dr. Shackle testifies that a person of ordinary skill in the art would have understood that "Chiang is disclosing that the power loss (area of shadow) of each successive phase switch (e.g., current controlling units $I_2$-$I_4$) is greater than that of the previous current limiter stage (i.e., current controlling units $I_1$-$I_3$, respectively)." *Id.* at 42 (citing Ex. 1003 ¶ 62 at 49–52). According to Dr. Shackle, "this means the phase switch of group n is capable of tolerating a relatively larger power than that of groups 1 to n-1." Ex. 1003 ¶ 62 at 51 (italics removed). To exemplify that point, he states that in Chiang's Figure 6, "the power dissipation of phase switches 2, 3, and 4 are each greater than the power dissipation of the previous phase switch (i.e., phase switches 1–3, respectively). *Id.* Although the final phase switch in Chiang's Figure 6 appears to show a smaller power dissipation, Dr. Shackle testifies that a skilled artisan would have "recognize[d] that the phase switch of the final group needs to be capable of

tolerating a relatively larger power than the switches of the other groups." *Id.* ¶ 62 at 51–52.

Patent Owner contends that Petitioner has failed to demonstrate Chiang discloses the limitations in claim 19 for a number of reasons. To begin, Patent Owner asserts that Petitioner's evidence indicates the "**actual** power dissipated by the LED groups" in Chiang's Figure 6, but "does not look at how 'capable' each phase switch is of tolerating power," as required by claim 19. PO Resp. 47. In support of that contention, Patent Owner refers to testimony by Petitioner's expert, Dr. Shackle, admitting that point. *Id.* (citing Ex. 2003, 105:14–23 (Dr. Shackle testifying that Figure 6 of Chiang shows power in normal operation and not the capability of tolerating power)). Patent Owner asserts that the amount of power a phase switch dissipates in normal operation is not the same as the phase switch's capacity to dissipate power and "Chiang provides no disclosure whatsoever regarding each phase switch's capacity to dissipate power." *Id.* at 47–48 (citing Ex. 2007 ¶ 106).

Additionally, Patent Owner contends that "[e]ven if Petitioner's methodology is accepted, Petitioner's evidence . . . shows that Chiang does not disclose claim 19." *Id.* at 48 (emphasis omitted). Patent Owner asserts that, for the claimed invention, "'group n' is the last group of the series, as Dr. Shackle admits." *Id.* at 47 (citing Ex. 2003, 58:24–60:2). From there, Patent Owner asserts, "[s]ince Chiang has 5 sets of LEDs, n equals 5," and "[t]o meet claim 19, Chiang would need to disclose that phase group 5 is capable of dissipating more power than groups 1 through n-1 (i.e., groups 1-4)." *Id.* at 49. Patent Owner notes, however, that it is undisputed that Chiang's Figure 6 shows that group 5 dissipates less power than group 4. *Id.* Insofar as Petitioner relies on Dr. Shackle's opinion that "the final phase

switch needs to be capable of dissipating excess power," Patent Owner responds that such testimony characterizes a POSITA's understanding of what Chiang's final phase switch "should" be able to do, not what Chiang expressly or inherently discloses that its final phase switch actually does. *Id.* at 49–50 (citing Pet. 43; Ex. 1003, 51).

In the Petitioner's Reply, Petitioner alleges that "[c]laim 19 simply requires a driver circuit with multiple phase switches, wherein one of the phase switches is capable of tolerating more power than that of the preceding phase switch(es)." Pet. Reply 16 (emphasis omitted). According to Petitioner, claim 19, and claim 15, from which it depends, "are open-ended such that 'group n' need not represent the last phase switch in the driver circuit." *Id.* at 17. Based on those contentions, Petitioner asserts that Chiang expressly discloses the limitation in claim 19 because Chiang's Figure 6 shows that its fourth phase switch dissipates more power than phase switches 1–3, and "as arranged," the Chiang's fourth switch may be considered switch "n" of the claim. *Id.*

In Patent Owner's Sur-reply, Patent Owner refers us to Dr. Shackle's testimony that contradicts Petitioner's assertions. In that testimony, Dr. Shackle acknowledges that group n in claim 15 refers to the last group of LEDs in the claim. PO Sur-reply 10–11 (citing Ex. 2003, 59:14–60:2). Patent Owner asserts also that "Petitioner's assertion that 'group n' is open-ended contradicts the claim language" reciting that the LEDs are divided "into n groups, said n groups of LEDs being electrically connected to each other in series in a sequence from group 1 to group n." *Id.* at 11 (quoting, in part, claim 15).

We have considered the arguments and the evidence presented by the parties. For the reasons discussed by Patent Owner, we agree that Petitioner

has not demonstrated that Chiang discloses "the phase switch of group n is capable of tolerating a relatively larger power than that of groups 1 to n-1," as recited by claim 19. In particular, we disagree with Petitioner's contention that "[c]laim 19 simply requires a driver circuit with multiple phase switches, wherein one of the phase switches is capable of tolerating more power than that of the preceding phase switch(es)." Pet. Reply 16 (emphasis omitted). Claim 19 expressly requires "the phase switch of group n is capable of tolerating a relatively larger power than that of groups 1 to n-1." Ex. 1001, 16:16–18. In other words, it is not enough to show that any one phase switch is capable of tolerating more power than a preceding phase switch or switches. Rather, it must be shown that "group n" has such a characteristic. And, as Patent Owner's and Petitioner's experts have agreed, a proper reading of claim 15 makes clear that a string of LEDs is divided into a total of "n groups" and that "group n" is the last or final group of the "sequence from group 1 to group n." Ex. 1001, 15:32–34; Ex. 2003, 59:14–60:2 (Shackle Deposition); Ex. 2007 (Zane Declaration) ¶ 104. Petitioner has not persuasively established otherwise with its unsupported attorney argument. Further, we agree with Patent Owner that Petitioner has not shown persuasively that Chiang's disclosure of the *actual* dissipation for the phase switches in Figure 6 demonstrates the *relative capability* of the phase switch of group n as compared to the phase switches of groups 1 to n-1. In other words, Petitioner has not shown persuasively that the actual power that the phase switches have tolerated is proportional to what the phase switches are capable of tolerating.

Moreover, to the extent that Petitioner argues that Chiang renders obvious claim 19, we find that challenge insufficiently articulated and inadequately supported. Pet. 42–43. In particular, Petitioner has not

proposed any modification of Chiang or demonstrated why and how it would have been obvious to modify Chiang's embodiment depicted in Figure 6 so that the phase switch of the last group would be capable of tolerating more power than that of group 1 to n-1.

Accordingly, we determine that Petitioner has not demonstrated by a preponderance of the evidence that claim 19 is anticipated or rendered obvious by Chiang.

*c) Claim 21*

Claim 21 depends from claim 15 and requires the driver circuit to further comprise "a dimming circuit." Ex. 1001, 16:22–23. Petitioner asserts that "Chiang discloses that the current value flowing through the active LED sets and phase switch (i.e., current controlling unit) is adjustable." Pet. 44. In particular, Petitioner refers to Chiang's claim 11, which recites, "A LED driving device . . . wherein the current value of said current controlling unit is adjustable." *Id.* at 44 (quoting Ex. 1004, claim 11). Petitioner also refers to Chiang's teaching that the "LED light output luminous intensity is proportional to LED current for most operating value of LED current." *Id.* (quoting Ex. 1004 ¶ 9). According to Petitioner and Dr. Shackle, a skilled artisan "knew this property of LEDs, and also knew that current control was conventionally used to provide dimming functionality for LEDs." *Id.* (citing Ex. 1003 ¶ 62 at 52–53; Ex. 1010, 1–2 (ANSI E1.3-2001 standard for using 0-10V control voltages for providing dimming)).

Based on the foregoing, Petitioner asserts that a person of skill in the art "would have understood that Chiang's disclosure of a current controlling unit with an adjustable current value was a disclosure of a dimming circuit."

Pet. 43–44 (citing Ex. 1004 ¶¶ 9, 35, claims 5 and 11; Ex. 1003 ¶ 62 at 52–53).

Patent Owner argues that Petitioner improperly reads the "dimming circuit" limitation onto the exact same component that it reads the "phase switch(es)" of independent claims 1 and 15, i.e., "the current controlling units." PO Resp. 50–51. For this contention, Patent Owner relies on its proposed construction for the term "dimming circuit" which would require it to be "a separate and distinct component from the phase switches." *Id.* at 51.

Additionally, Patent Owner contends that Petitioner has failed to demonstrate that the current controlling units of Chiang are a dimming circuit. *Id.* at 52. According to Patent Owner, Chiang does not disclose dimming or dimming circuits by disclosing current control. *Id.* Patent Owner asserts that "the '722 patent makes clear that the concepts of current control and a dimming circuit are distinct." *Id.* (citing Ex. 1001, 2:22–26, 1:64–66 (disclosing driver circuits with either passive current control or active current control, and dimming)).

In Petitioner's Reply, Petitioner asserts that "[t]he '722 patent describes circuitry that creates a 'dimming effect' by simply turning off LED groups." Pet. Reply 3 (citing Ex. 1001, 4:27–31, 5:26–27). Petitioner asserts that because the phase switches are part of this on/off circuitry, the phase switches need not be separate and distinct form the dimming circuit. *Id.* (citing Ex. 1040, 28:11–37:17).

Petitioner also contends that Patent Owner "incorrectly relies on a presumption that separate claim elements claim *physically* separate and distinct components." *Id.* at 4 (quoting PO Resp. 25). Petitioner asserts that the proper standard is that "[t]he use of two terms in a claim requires that they connote different meanings, not that they necessarily refer to two

different structures." *Id.* (quoting *Applied Med.*, 448 F.3d at 1333 n.3). According to Petitioner, as recited, the "dimming circuit" only needs to be part of the driver circuit, and "not 'separate and distinct' from other elements of the driver circuit (e.g., phase switches in combination with resistor networks and/or variable resistors.)" *Id.* at 5.

In the Patent Owner's Sur-reply, Patent Owner asserts that the "dimming circuit" must be a "**structure** that included at least some circuitry separate from the phase switches that alters their normal functioning." PO Sur-reply at 6. According to Patent Owner, Petitioner's argument fails because "it reads what it identifies as the 'phase switch' onto the 'dimming circuit' with no additional circuitry." *Id.*

Having considered the evidence and the arguments, we determine that the preponderance of the evidence supports Petitioner's assertion that Chiang's driver circuit further comprises a dimming circuit, as required by claim 21. As discussed in our claim construction discussion, we have declined to adopt Patent Owner's proposed construction for "dimming circuit." Patent Owner did not identify, nor did we find, any suggestion from the Specification description or claim 21 that prohibits the phase switches from being part of the dimming circuitry. Dr. Shackle credibly testifies that a skilled artisan would have known that current control was conventionally used to provide dimming functionality for LEDs. Ex. 1003 ¶ 62 at 52–53. As explained persuasively by Petitioner and Dr. Shackle, a person of ordinary skill in the art would have understood that Chiang describes a dimming function when it recites in claim 11 that "the current value of said current controlling unit is adjustable" in its driver circuit, Ex. 1004, claim 11, and teaches that the "LED light output luminous intensity is proportional to LED current for most operating value of LED

current," *id.* ¶ 9. Thus, we do not rely on "the exact same component" disclosed in Chiang for the dimming circuit and the phase switches. It is Chiang's disclosure of current controlling units *with additional functionality*—an adjustable current value—that meets the "dimming circuit" claim limitation, whereas such added functionality is not required for the "phase switches" limitation. Based on the foregoing, we assign persuasive weight to Dr. Shackle's conclusion that a person of skill in the art would have understood that Chiang's disclosure of a current controlling unit with an adjustable current value was a disclosure of a driver circuit further comprising a dimming circuit. Thus, we find that Chiang discloses that claim element.

Accordingly, we determine that Petitioner has shown by a preponderance of the evidence that Chiang anticipates claim 21.

*d) Claim 1*

As set forth above in Section I.D., independent claim 1 is directed to a method for driving LEDs in multiphase. Petitioner has identified the disclosures in Chiang that Petitioner asserts correspond to each element of claim 1. *See* Pet. 20–36. In doing so, Petitioner again refers to its modified version of Chiang's Figure 5A. *Id.* at 21–25. The structural modifications Petitioner makes to Chiang's Figure 5A appear to be directed primarily to the limitation in claim 1 requiring "separately coupling each of the [LED] groups to a ground through separate conductive paths." We refer to this limitation as the "ground coupling limitation of claim 1" and focus on that limitation in this discussion as it represents a point of contention between the parties that was not at issue in claim 15.

For the ground coupling limitation of claim 1, Petitioner asserts that Chiang discloses this limitation by referring to Chiang's descriptions of the

current path set forth above, and to Petitioner's modified version of Chiang's Figure 5A, asserting that the figure discloses "a separate conductive path to ground (identified in red) for each of the LED sets (groups) $D_1$, $D_2$, $D_3$, . . . , $D_{n-1}$, and $D_n$ (highlighted blue) through 'grounded current controlling unit[s] $I_1$, $I_2$, $I_3$, . . ., $I_{(n-1)}$, and $I_n$ (highlighted purple)." *Id.* at 23–24.

Patent Owner argues that Petitioner fails to demonstrate that Chiang discloses the ground coupling limitation. PO Resp. 41. Patent Owner asserts that Petitioner relies on a modified version of Chiang's Figure 5A, that "represents Petitioner's combination of Chiang and Sedra (Ex. 1009) and does not appear anywhere in Chiang." *Id.* (citing Pet. 10–12). Additionally, referring to the modified version of Chiang's Figure 5A, Patent Owner asserts that the red element in the figure which Petitioner identifies as the separate conductive path to ground is not depicted as connected to the ground added by Petitioner. *Id.* Further, Patent Owner asserts that "Petitioner fails to provide any theory for why **each** red element can be considered 'separately' coupled to ground." *Id.* (citing Pet. 23).

In Petitioner's Reply, Petitioner asserts that Patent Owner's arguments lack merit based on the testimony of Patent Owner's expert, Dr. Zane. Pet. Reply 7. Specifically, Petitioner directs us to testimony by Dr. Zane, including his testimony conceding that: (a) Chiang discloses a path from the voltage source through LED group 1 and CCU $I_1$ to ground, *id.* at 8–9 (citing Ex. 1040, 77:4–80:14); and (b) the outputs of all five CCUs in Chiang are electrically connected to ground, *id.* at 9 (citing Ex. 1040, 80:8–81:12). Additionally, Petitioner directs us to Dr. Zane's testimony agreeing that Dr. Shackle's correction to Chiang's Figure 5a reflects a skilled artisan's understanding of Chiang's disclosure. *Id.* at 12–13 (citing Ex. 1040, 71:18–76:10, 81:13–82:7). Petitioner refers also to Dr. Zane's testimony agreeing

to Petitioner's identification of the location of the common ground node and his opinion that the circuit schematic would have the same meaning to a skilled artisan regardless of where the ground symbol is drawn in the ground node. *Id.* at 8–11 (citing Ex. 1040, 82:8–24, 83:14–84:19).

In Patent Owner's Sur-reply, Patent Owner argues that Petitioner's "mighty effort to rewrite Chiang" amounts to a "recognition that the disclosure is at best confusing to a POSITA, and nothing in Dr. Zane's testimony rebuts this." PO Sur-reply 8.

We have considered the arguments and evidence of the parties and determine that Petitioner has shown by a preponderance of the evidence that Chiang discloses the "ground coupling limitation of claim 1." In particular, Petitioner has identified Chiang's disclosure that its "current switching circuit 10 include[s] grounded current controlling unit I1, I2, I3, …, I(n−1), and In" and "[t]he current path is power source Vs, ***LED set $D_1$, and current controlling unit $I_1$, and ground***. ... The new current path is power source Vs, LED set $D_1$, ***LED set $D_2$, and current controlling unit $I_2$, and ground***." Pet. 23–24 (discussing claim element [1c] and quoting Ex. 1004 ¶¶ 33, 38). Petitioner illustrates, with a side-by-side comparison of its modified versions of Chiang's Figure 5A and the '722 patent's Figure 1, as set forth above in Section II.D.2, how "the LED driver circuit disclosed in Chiang is virtually identical to that shown in FIG. 1 of the '722 patent." *Id.* at 40. Additionally, referring to that same modified version of Chiang's Figure 5A, Dr. Shackle identifies how the figure shows a separate conductive path to ground for each of the LED groups, and that those paths go through the respective grounded CCUs, as disclosed in Chiang's description of the current path. Ex. 1003 ¶ 62 at 34. Further, Petitioner supports its position and Dr. Shackle's testimony with the testimony of Patent Owner's expert, Dr. Zane,

who agreed that the pathways identified by Dr. Shackle each lead to a separate grounded node.

Insofar as Patent Owner urges that Petitioner has made some "mighty effort to rewrite Chiang" and that doing so demonstrates that the reference is "at best confusing to a POSITA," we disagree. PO Sur-reply 8. Patent Owner cites to no testimony or other evidence establishing or even suggesting that Chiang's disclosure is confusing. Rather, when discussing the drafting error in Chiang's Figure 5A, Petitioner's expert, Dr. Shackle, testifies that "[a] POSITA would understand that this is an error based on the express disclosures in Chiang." Ex. 1003 ¶ 44. Dr. Shackle corrected the error by redrawing the connection from the CCUs to the power input source so that the connection leads instead to the bridge rectifier, and to add a ground in that redirected connection pathway. *Id.* ¶ 46. Dr. Zane testified that this correction was "reasonable" and he agreed that it was necessary for the bridge rectifier to operate as a full-wave rectifier. Ex. 1040, 81:16–82:7. Additionally, Dr. Zane testified that the placement of the ground symbol is not significant in a circuit schematic. *Id.* at 83:21–84:7. Patent Owner has not identified anything "confusing" about Chiang's disclosure based on that testimonial evidence by both parties' experts. Rather, we find that, based on the evidence as a whole, Petitioner has shown persuasively that the correction made by Dr. Shackle in Petitioner's modified version of Chiang's Figure 5A reflects the written description in Chiang and is approved by Patent Owner's expert. As our reviewing court has stated, "[e]xpert testimony may shed light on what a skilled artisan would reasonably understand or infer from a prior art reference." *Acoustic Tech., Inc. v. Itron Networked Solutions, Inc.*, 949 F.3d 1366, 1373 (Fed. Cir. 2020).

Other than the ground coupling limitation, our analysis of claim 1 is the same as that for claim 15.

Accordingly, we determine that Petitioner has demonstrated by a preponderance of the evidence that Chiang discloses each limitation of independent claim 1. Having determined that Chiang anticipates claim 1, we do not reach Petitioner's contention that claim 1 is also rendered obvious by Chiang.

*e) Claims 2, 3, and 10*

Each of claims 2, 3, and 10 depends from claim 1. Claim 10 recites, "[t]he method of claim 1, further comprising: decreasing the input voltage from the power source to turn off the LEDs, group by group in a reverse sequence upstream the string." Petitioner demonstrates persuasively how Chiang discloses this further limitation. Pet. 35–36 (citing Ex. 1003 ¶ 62 at 42; Ex. 1004, Fig. 6); Ex. 1004 ¶ 42. Patent Owner does not challenge that showing beyond alleging that Petitioner has not shown that Chiang discloses the same elements of claim 1 discussed in the preceding section. We do not find those arguments persuasive for the same reasons discussed above. Accordingly, we determine that Petitioner has shown by a preponderance of the evidence that Chiang anticipates claim 10.

Petitioner has also identified each disclosure in Chiang that it asserts meets the limitations of claims 2 and 3. Patent Owner challenges that showing in the same manner as claims 1 and 10, discussed in the preceding sections. We do not find those arguments persuasive for the same reasons discussed therein. The only other limitation of the claims in dispute is their requirement that the method for driving LEDs in multiphase further comprises "monitoring a phase voltage of each group" of LEDs. Thus, we focus on that limitation in our following discussion.

Petitioner asserts that Chiang's voltage detector measures the voltage of the power source (after it has passed through the rectifier) and determines the phase voltage of each group (i.e., LED set) based on the barrier voltage of each group." Pet. 30 (citing Ex. 1004 ¶ 38). Petitioner contends that means that "by knowing the barrier voltage of each group of LEDs and the input voltage, the voltage detecting circuit determines the phase voltage of each group, and then uses that information to activate and deactivate different current controlling units to drive the maximum number of groups of LEDs." *Id.* at 31. According to Petitioner, "Chiang is 'monitoring' the phase voltage of each group by measuring the input voltage and then using a known physical quantity (the sum of the barrier voltages of the upstream groups) to deduce the monitored value from the value being measured." *Id.* (citing Ex. 1003 ¶ 62 at 42), *see also id.* 33.

Patent Owner asserts that Chiang does not disclose "monitoring a phase voltage." According to Patent Owner, because Chiang's "voltage detector measures the voltage of the power source," as Petitioner admits, it monitors an input voltage, which is required by unchallenged claim 4. PO Resp. 43 (quoting Pet. 19–20, 33). However, because the voltage detector does not measure the phase voltage of each group, it does not monitor the phase voltage, as required by challenged claims 2 and 3. *Id.* Patent Owner asserts that the embodiments disclosed in the '722 patent monitor phase voltage via direct measurement and not in the deduced manner that Petitioner demonstrates for Chiang. *Id.* at 44 (citing Ex. 2007 ¶¶ 101–102). Further, Patent Owner asserts that the phase voltage depends on more variables than the sum of the barrier voltages of the LEDs in the group, and those variables can change over time. *Id.* at 45. Additionally, Patent Owner refers us to the testimony of Dr. Shackle who explained that he did not apply

what he would consider to be "precisely the normal meaning" of the term "monitors." *Id.* at 45–46 (citing Ex. 2003, 82:16–84:9).

In Petitioner's Reply, Petitioner asserts that the claims do not require "direct" monitoring of the phase voltage. Pet. Reply 15. Petitioner asserts that Chiang uses indirectly-monitored phase voltages. *Id.* at 16. According to Petitioner, the '722 patent also discloses deducing phase voltages via known circuit relationships, as depicted in Figures 5 and 6. *Id.*

In Patent Owner's Sur-reply, Patent Owner asserts, among other things, that "Dr. Shackle's admission that he did not use the 'normal meaning' of 'monitor' but 'a very special meaning of it' . . . is fatal to Petitioner's theory – Petitioner relies upon a 'meaning' of 'monitor' that is something other than its plain and ordinary meaning." PO Sur-reply 9.

Having considered the arguments and the evidence, we determine that Petitioner has not established persuasively that Chiang discloses "monitoring the phase voltage," as required by claims 2 and 3. Petitioner frames the issue as simply whether the claims preclude indirect monitoring, asserting that they do not. We view the issue differently. Even if indirect monitoring is sufficient for the claims, Petitioner must demonstrate persuasively that it is the phase voltage that is indirectly monitored. Here, we find that Petitioner's evidence falls short in view of the record as a whole. In particular, Petitioner's expert, Dr. Shackle, testifies that Chiang "computes and monitors the phase voltage of each group (i.e., LED set) based on the barrier voltage of each group," and also "monitors the phase voltage of each group by measuring the input voltage and then using a known physical quantity (the sum of the barrier voltages of the upstream groups) to deduce the monitored value from the value being measured." Ex. 1003 ¶ 62 at 42. According to Dr. Shackle, "Chiang 'monitors' the phase voltage of the LED

groups in the same way that an observer 'monitors' temperature with a thermometer. Neither is directly measuring the monitored quantity; both are determining the monitored quantity based on a known relationship to what is actually measured." Ex. 1003 ¶ 62 at 43.

However, Patent Owner's expert, Dr. Zane, challenges those opinions by Dr. Shackle by testifying that "the deduction Dr. Shackle is referring to in order to compute an estimate of the phase voltage based on measuring the input voltage depends on many variables and factors that are not strictly known, and the result is not equivalent to 'monitoring a phase voltage of each group.'" Ex. 2007 ¶ 100. Dr. Zane describes some of those variables in his declaration. *Id.* According to Dr. Zane, those variables "could result in significant uncertainty in a computed estimate of the phase voltage." *Id.* Additionally, Dr. Zane testifies that "the sum of the barrier voltages is not the same as the phase voltage, as the phase voltage is typically greater than this sum . . . ." *Id.* Further, Patent Owner directs us to Dr. Shackle's deposition testimony acknowledging that the barrier or threshold voltage of the LEDs within each phase group in Chiang are not equivalent to the phase voltages. PO Resp. 45 (citing Ex. 2003, 81:9–20). Patent Owner also directs us to Dr. Shackle's deposition testimony explaining that he is referring to some "very special meaning" of the term "monitor," when he explains how Chiang "monitors" the phase voltage. *Id.* at 45–46 (quoting Ex. 2003, 82:16–84:9).

What is especially concerning is that Petitioner's Reply does not address Dr. Zane's challenges to Dr. Shackle's testimony. *See* Pet. Reply 15–16. Instead, Petitioner focuses on its argument that the claims do not include a "direct" monitoring requirement. *See id.* Thus, Dr. Zane's testimony remains unrebutted on the record as a whole. Moreover, we

decline to assign persuasive weight to Dr. Shackle's testimony because it is admittedly based on a "very special meaning" of the term "monitor" that has not been proposed for claim construction and because Petitioner has not demonstrated a sufficient basis for departing from the term's ordinary meaning. *See* Ex. 2003, 82:16–84:9.

Accordingly, we determine that, based on the record as a whole, Petitioner has not adequately demonstrated that Chiang discloses "monitoring the phase voltage," as required by claims 2 and 3. Based on that deficiency, we determine that Petitioner has not established by a preponderance of the evidence that Chiang anticipates claims 2 and 3.

Although Petitioner also asserts that Chiang renders obvious claims 2 and 3, Petitioner does not support those assertions with any argument relating to these claims. *See* Pet. 33, 35. Thus, Petitioner has not shown by a preponderance of the evidence that these claims would have been rendered obvious by Chiang.

### *E. Obviousness based upon Chiang and Leung*

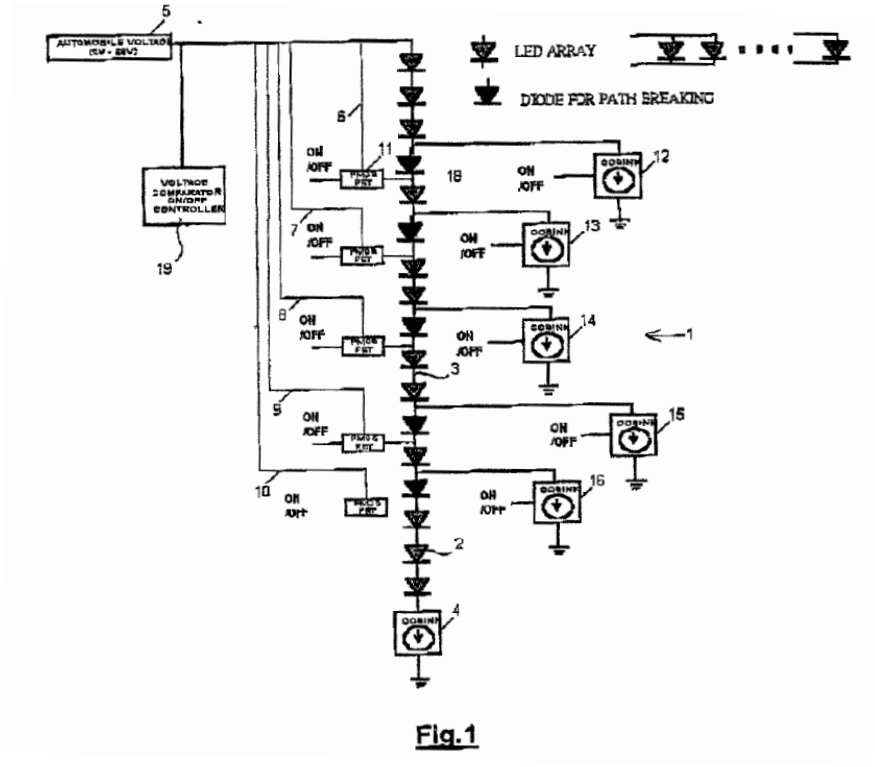
Petitioner asserts that claims 2 and 3 are rendered obvious over the combination of Chiang and Leung. Pet. 45–52. Petitioner relies on Chiang as disclosing the elements of claim 1, from which claims 2 and 3 depend. *Id.* at 48, 51 (referring to its anticipation ground to assert that "Chiang discloses claim 1."). Petitioner combines Leung to reach the additional limitations of the dependent claims. *Id.* at 48–52. We focus on those limitations here.

#### *1. Leung*

Leung relates to a solid state lighting array driving circuit which is intended for use with automobiles. Ex. 1005 ¶ 1. Leung explains that "[t]he

driving circuit may be used for other lighting situation[s], particularly where the power supply may fluctuate." *Id.*

Leung's Figure 1 is set forth below:




Leung's Figure 1 depicts a schematic diagram of a circuit in accordance with a preferred embodiment of the invention. *Id.* ¶ 39. In circuit 1, a plurality of solid-state lighting devices in the form of LEDs 2 are provided and "arranged in an array incorporating a serial path 3 through each of the LEDs and terminating in a constant current sink 4 or similar device." *Id.* ¶ 41. Leung explains,

> [W]hen connected to a power supply, each of the LEDs may operate and the constant current [s]ink 4 is used to regulate the current and dissipate excess power supplied to the array. The power supply is indicated generally by the item 5 being a supply DC current which, in the case of automobiles or other uses, may be variable between different levels.

*Id.* The driving circuit comprises a control means to control a switch in a switchable parallel path so that the array of lighting devices may be reconfigured into an alternative set of series circuits to alter the quantity of lighting devices in one or more of the series circuits in response to changes in the voltage in the circuits. *Id.* ¶ 16. Leung discloses that "[t]he reconfiguration involves switching upon sensing of the incoming voltage" in a preferred embodiment. *Id.* ¶ 61. Leung also discloses that "other forms of detection could be used such as detecting the voltage at the constant current devices which, when higher than a specific threshold could indicate a desire to rearrange the circuit to incorporate one or more further LEDs into each of the parallel paths." *Id.*

*2. Discussion*

Petitioner asserts that Leung discloses a method of monitoring a phase voltage of each group of LEDs in its LED driver circuit by direct measurement. Pet. 48. In support of that assertion, Petitioner refers to Leung's disclosure that it detects the voltage at the constant current sinks/devices. *Id.* (citing Ex. 1005 ¶ 61). Petitioner asserts that Leung's Figure 1 shows that the constant current sinks are located at the downstream end of each of the LED groups. *Id.* According to Petitioner, "Leung discloses directly measuring the 'phase voltage' of each group of LEDs because . . . the 'phase voltage' of a group of LEDs is the voltage at their downstream end." *Id.* at 49. Petitioner contends that "it would have been obvious to a POSITA to use Leung's direct measurement of phase voltage in the circuit shown in Chiang's FIG. 5 to make the circuit more efficient and the circuit controller easier to configure." *Id.* Petitioner asserts that modification of Chiang in view of Leung provides the claimed "monitoring a phase voltage of each group" by directly measuring each group's phase

voltage. *Id.* For the remaining limitation in claims 2 and 3 requiring turning off the phase switch based on the phase voltage, Petitioner relies on Chiang's disclosure in Figure 6 for the operation of the circuit. *Id.* at 50. According to Petitioner, "[s]ubstituting Leung's direct measurement of phase voltage for Chiang's indirect monitoring of phase voltage would not change this operation—it would simply allow the moment where the phase voltage of a downstream group exceeds $V_d$ [the voltage across the corresponding CCU] to be detected directly." *Id.* at 51.

Patent Owner argues that "Petitioner provides no reason why a POSITA would look to Leung to use a different current controlling circuit than one already disclosed in Chiang." PO Resp. 61. According to Patent Owner, their teachings are diametrically opposed because "Chiang is designed specifically to work with an AC power source whereas Leung is designed specifically to work with a DC power source from an automobile battery." *Id.* Patent Owner asserts that difference matters because Chiang is directed to improving power factor, which is a metric only applicable to AC power. *Id.* Patent Owner contends that a circuit like Leung's that "turns on multiple current sources at a time is contrary to the teachings of Chiang as this would reduce power factor." *Id.* at 62 (citing Ex. 2007 ¶¶ 115–118).

Additionally, Patent Owner argues that Petitioner has not explained sufficiently how to implement what Leung describes as one of the "other forms of detection" that could be used to detect the voltage at the constant current sinks/devices. *Id.* at 63 (emphasis omitted). Patent Owner asserts that Leung does not disclose an embodiment implementing such an alternative. *Id.* According to Patent Owner, Leung merely discloses it as a possible alternative, with no enabling disclosure as to how to implement the detection scheme. *Id.* Further, Patent Owner asserts that the only

motivation provided by Leung for detecting the voltage at the constant current sinks is "when higher than a specific threshold could indicate a desire to rearrange the circuit to incorporate one or more further LEDs into each of the parallel paths," which Petitioner has not shown would have applied to Chiang. *Id.* at 63–64. According to Patent Owner, "Petitioner's proffered motivation to combine is not rooted in the references nor is it supported by anything beyond conclusory argument." *Id.* at 64 (citing Pet. 47–48). Patent Owner asserts that we should not afford persuasive weight to Dr. Shackle's testimony relating to motivation because it lacks citation to any evidence. *Id.* at 65.

Patent Owner asserts also that Petitioner has failed to adequately address whether there would have been a reasonable expectation of success in combining the teachings of Chiang and Leung. *Id.* (citing Pet. 45–48).

Regarding the final limitations in claim 2 and 3, Patent Owner asserts that neither Chiang nor Leung teaches switching off any phase switch based on any voltage reaching a predetermined value. *Id.* at 66–67. Patent Owner asserts that Chiang switches phase switches based on the input voltage and Leung does not teach turning off phase switches based upon the voltages that it monitors. *Id.* at 67.

In Petitioner's Reply, Petitioner urges that its proposed combination "requires nothing more than applying Leung's direct-monitoring technique to Chiang's driver circuit in order to obtain a predictable result: Chiang's lighting device modified to turn its CCUs on/off based on direct rather than indirect voltage monitoring." Pet. Reply 20–21. Petitioner responds to Patent Owner's challenge of its motivation for combining the references by asserting that "[w]here two known alternatives are interchangeable for a desired function, an express suggestion to substitute one for another is not

needed to render [the] substitution obvious." *Id.* at 21 (citation omitted). Petitioner responds to Patent Owner's contentions regarding the differences in the design of Chiang and Leung as "a distraction." *Id.* at 20. According to Petitioner, the combination is based on Leung's teaching that direct monitoring may be used instead of indirect monitoring. *Id.* Petitioner asserts that Patent Owner's argument that Leung is non-enabling is unavailing because the proposed modification simply uses directly-monitored phase voltages instead of deduced values. *Id.* at 22.

In Patent Owner's Sur-reply, Patent Owner reiterates that Petitioner has not adequately addressed the differences between Chiang and Leung, or provided a motivation to modify Chiang in view of Leung. PO Sur-reply 15–16. Patent Owner also asserts again that Leung mentions an alternative voltage detection method without teaching how to implement it. *Id.* at 16.

Having considered the arguments and the evidence, we determine that Petitioner has not demonstrated persuasively that a person of skill in the art would have modified Chiang to include a direct means of monitoring the phase voltage in its driver circuit. In particular, we find that Petitioner has not shown that doing so amounts to a simple substitution of Chiang's "indirect monitoring" of the phase voltage with a method of directly monitoring the phase voltage because Petitioner has not established sufficiently that Chiang monitors the phase voltage directly or indirectly, for the reasons discussed above in Section II.D.2.e. Further, we agree with Patent Owner that Petitioner and Dr. Shackle have not explained sufficiently how their proposed modification of Chiang in view of Leung would have been implemented. Leung describes only "detecting the voltage at the constant current devices." Ex. 1005 ¶ 61. Petitioner and Dr. Shackle have not described how Chiang's driver circuit would have been modified to

include such a detecting function nor explained persuasively why a skilled artisan would have reasonably expected it to successfully monitor the phase voltage in Chiang's circuit.

Accordingly, we determine that Petitioner has not demonstrated by a preponderance of the evidence that the combination of Chiang and Leung renders obvious claims 2 and 3.

### *F. Obviousness based upon Chiang and Hamilton*

Petitioner asserts that claims 11, 12, 18 and 21 are rendered obvious over Chiang and Hamilton. Pet. 52–62. Petitioner relies on Chiang as disclosing the elements of claim 1, from which claims 11 and 12 depend. *Id.* at 48, 55, 62 (referring to its anticipation ground to assert that "Chiang discloses claim 1."). Petitioner relies on Chiang as disclosing the elements of claim 15, from which claims 18 and 21 depend. *Id.* at 60–61, 65 (referring to its anticipation ground to assert that "Chiang discloses claim 15."). Petitioner relies on Hamilton to reach the additional limitations of the challenged dependent claims. We focus on those limitations here.

#### *1. Hamilton*

Hamilton is a book titled "Basic Integrated Circuit Engineering." Ex. 1006, 10. Hamilton describes a current drive circuit, explaining that it "serves to translate a reference voltage into a reference current which is then used to drive the ladder network." *Id.* at 424. Hamilton explains also that the circuit "must perform a level translation from the grounded reference to a negative voltage to which current can flow from the ladder network." *Id.* Hamilton's Figure 11-24 is set forth below:

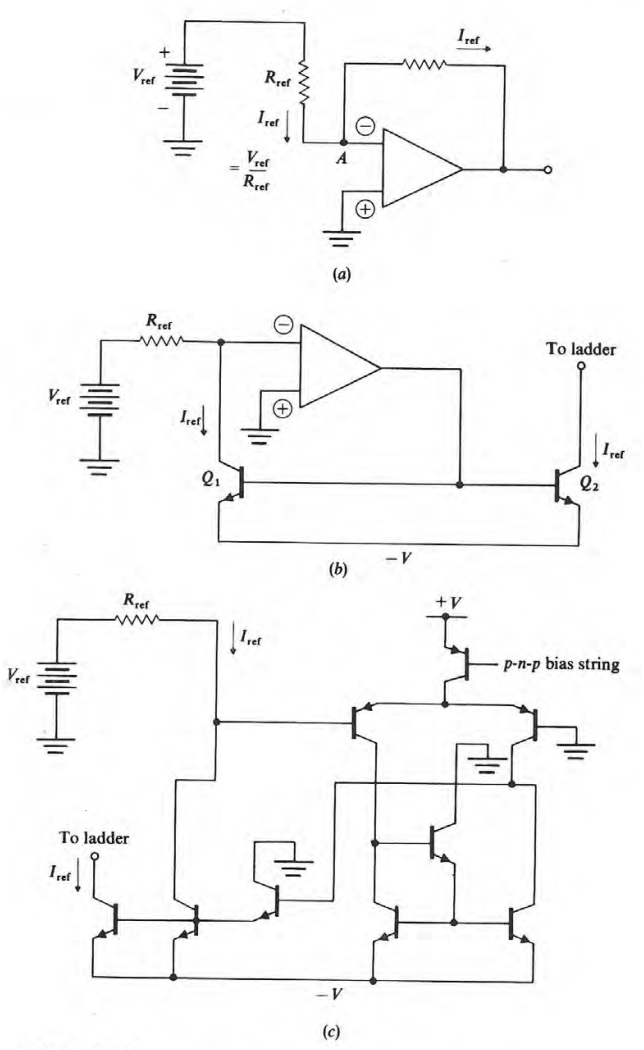



FIGURE 11-24
(*a*) Reference circuit with amplifier; (*b*) use of transistors in the feedback loop; (*c*) simplified amplifier in a reference circuit.

*Id.* at 425, Fig. 11-24. Hamilton's Figure 11-24 depicts three illustrations: (a) a reference circuit, (b) use of transistors in the feedback loop, and (c) a simplified amplifier circuit. *Id.* Hamilton teaches,

> Here again, a virtual-ground node in a negative-feedback loop is useful. A system to generate the reference current is shown in Fig. 11-24a. Since point A is maintained at zero volts, being the virtual ground, the reference voltage $V_{ref}$ appears across the reference resistor $R_{ref}$ to produce reference current $I_{ref} = V_{ref} / R_{ref}$. In the circuit of Fig. 11-24a, a feedback resistor is used to close the loop; however, a current-source transistor can be used as well. Recall, from the biasing discussion, that an identical

> transistor Q2 can be slaved to the feedback transistor Q1 to generate the ladder drive current.
>
> The amplifier circuit should combine both the gain needed to close the loop and the driver-end level translation. A simple circuit to accomplish these two objectives is the input stage from the μA741 circuit discussed earlier. The complete circuit is shown in Fig. 11-24c. The complete digital-to-analog circuit, including current weighting ladder, terminating circuits, and bias and current drive circuit, is shown in Fig. 11-25.

*Id.* at 424–26.

*2. Discussion*

*a) Analogous Art*

Patent Owner challenges Petitioner's reliance on Hamilton, asserting that the reference "is relevant to the field of driving LEDs at all." PO Resp. 67–68 (citing Ex. 2007 ¶ 125). Patent Owner supports that contention by asserting that Hamilton does not describe driving a string of LEDs. *Id.*

In Petitioner's Reply, Petitioner asserts that Hamilton is analogous art because it is "reasonably pertinent" to the problem at hand because Hamilton describes a type of control-and-feedback current-controlling circuit that was ubiquitous, well-known, and predictable. Pet. Reply 23 (citing Ex. 1039, Ch. 1.6).

In Patent Owner's Sur-reply, Patent Owner asserts that "Petitioner has failed to identify and compare any problems to which both the '722 patent and Hamilton relate." PO Sur-reply 17 (citing *Donner Tech., LLC v. Pro Stage Gear, LLC*, 979 F.3d 1353, 1359 (Fed. Cir. 2020)) (emphasis omitted).

As the Federal Circuit has explained,

> A reference is appropriate prior art if within the field of the inventor's endeavor. *Bausch & Lomb, Inc. v. Barnes–Hind/Hydrocurve, Inc.*, 796 F.2d 443, 449 (Fed. Cir. 1986). Alternatively, a reference qualifies as prior art if "reasonably pertinent to the particular problem with which the inventor was

> involved." *Id.* "A reference is reasonably pertinent if, even though it may be in a different field of endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem." *In re GPAC Inc.*, 57 F.3d 1573, 1578 (Fed. Cir. 1995) (quotations and citations omitted). If a reference's disclosure relates to the same problem as the claimed invention, "that fact supports use of that reference in an obviousness rejection." *In re Clay*, 966 F.2d 656, 659 (Fed. Cir. 1992).

*Princeton Biochemicals, Inc. v. Beckman Coulter, Inc.*, 411 F.3d 1332, 1339 (Fed. Cir. 2005). Whether a reference is analogous art is an issue of fact. *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1378 (Fed. Cir. 2007). We note that in *Donner*, referenced by Patent Owner, the Court explained that it was necessary for the Board to "identify and compare the purposes or problems" to which the cited reference and the challenged patent relate to apply the proper standard in determining whether the cited reference is analogous art. *Donner*, 979 F.3d at 1360–1361 (citing *Sci. Plastic Prods., Inc. v. Biotage AB*, 766 F.3d 1355, 1360 (Fed. Cir. 2014) ("The analogous art inquiry is a factual one, requiring inquiry into the similarities of the problems and the closeness of the subject matter as viewed by a person of ordinary skill.")).

There seems to be no dispute that Hamilton is not in the same field of endeavor as the '722 patent. Thus, we analyze Hamilton to determine if it is "reasonably pertinent" to the particular problem with which the inventor was involved. As noted in the Petition, the '722 patent describes using a control mechanism in its driver circuit "known as control and feedback." Pet. 54 (citing Ex. 1001, 7:37–48). Indeed, as Petitioner asserts, the Specification states that "[c]ontrol and feedback theory are well-known. Its theory and its various configurations are well documented in many text books and are

widely used." *Id.* at 54–55 (quoting Ex. 1001, 7:37–48). The Specification discusses the control and feedback mechanism in its description of the "[t]heory of operation" for its multiphase LED driver circuit. Ex. 1001, 7:20. In that same passage, the Specification explains the significance of the control feedback method used:

> *How close Vf1 can be regulated to VREF and how fast for the control loop to do so depends on the control feedback method* used and the limit of practical circuit components such as OpAmp's gain bandwidth, input offset Voltage, input bias current, etc. For simplicity, *the embodiment of the invention does not describe all of the control and feedback variations* and practical component limitations in the figures. Applying those control and feedback variation does not depart from the scope of this invention.

*Id.* at 7:43–52 (emphases added). Thus, we see from the Specification of the '722 patent that: (a) the operation of the driver circuit utilizes a control and feedback method, (b) such method determines how close Vf1 can be regulated to VREF and how fast for the control loop, (c) all of the known control and feedback variations are not described in the figures, and (d) those various configurations are well documented in many text books and are widely used. In other words, the '722 patent is concerned with selecting and providing a control feedback configuration to operate and control its driver circuit. We find that Hamilton is an example of a text book, referred to in the '722 patent, that discloses a configuration for a control and feedback mechanism. Thus, we find that, even though it may be in a different field of endeavor, Hamilton "logically would have commended itself to an inventor's attention" when considering known control and feedback mechanisms used in circuitry. *See In re GPAC Inc.*, 57 F.3d 1573

at 1578. Accordingly, we find that the record demonstrates that Hamilton is analogous art.

*b) Motivation to Combine*

Having recognized Hamilton as analogous art, we next consider Patent Owner's related argument that Petitioner fails to establish a motivation to combine Chiang and Hamilton. PO Resp. 68–70. Specifically, Patent Owner asserts that "there is no evidence or argument from Petitioner that a POSITA would be motivated to combine an LED driving circuit with a portion of a digital-to-analog conversion circuit." *Id.* at 68. As in its analogous art argument, Patent Owner emphasizes that Hamilton is a textbook on "advance circuitry on digital-to-analog conversion," compared to Chiang's disclosure of an LED driving circuit. *Id.* at 68–69 (citing Ex. 2007 ¶¶ 126–127). Patent Owner also argues that Petitioner has not shown whether or why a skilled artisan would have had a reasonable expectation of success in combining the teachings of Chiang and Hamilton. *Id.* at 69. Additionally, Patent Owner asserts that Petitioner has failed to explain how to combine the references without rendering Chiang inoperable. *Id.* at 69–70 (citing Ex. 2007 ¶¶ 126–127).

Based on our review of the record as a whole, we find that Petitioner has persuasively demonstrated that a skilled artisan would have been motivated to combine Chiang and Hamilton in the manner proposed. In particular, as Petitioner asserts, Pet. 53, Chiang discloses that its CCU "can be accomplished by any current controlling circuit," Ex. 1004 ¶ 39. We credit Dr. Shackle's testimony that "[a] POSITA would have understood one such control circuit is disclosed in Hamilton . . . in the form of a control and feedback mechanism." Ex. 1003 ¶ 77. He testifies further that "[d]oing so would merely require implementing a well-known, effective, and reliable

type of circuit." *Id.* ¶ 79. Dr. Shackle explains that Hamilton's operation was "well known and predictable and provides a simple way to implement Chiang's current control unit that merely requires conventional components that were familiar to a POSITA." *Id.* We find that such testimony has not been adequately rebutted.

*c) Claim 11*

Claim 11 depends from method claim 1 and further recites,

> [11a] regulating a phase current flowing through the phase switch, so that when the phase current reaches a regulated value programmed by a reference, it follows the reference with the increase of the input voltage; and
> [11b] reducing the phase current of an upstream group to a minimal level or *turning off the phase switch of the upstream group, when the phase current of a next group down stream said upstream group reaches its regulated value with the increase of the input voltage*.

Ex. 1001, 15:12–20 (emphasis and element brackets added).

Petitioner asserts that Chiang discloses limitation 11a because Chiang's CCUs are phase switches and each CCU regulates the current flowing through it to a constant value. Pet. 55 (citing Ex. 1004 ¶ 38) ("To keep brightness, the current of the current controlling unit is designed to a constant value.").

Petitioner combines Hamilton with Chiang to reach the requirement that "when the phase current reaches a regulated value programmed by a reference, it follows the reference with the increase of the input voltage." *Id.* Petitioner refers to Chiang's teaching that its CCU "can be accomplished by any current controlling circuit." *Id.* at 56 (quoting Ex. 1004 ¶ 39). Petitioner asserts that it was well known at the time of the invention "to use/implement a current controlling circuit with a control and feedback

mechanism, such as the one shown in FIG. 11-24b of Hamilton." *Id.* (citing Ex. 1003 ¶ 86 at 67). Petitioner asserts that in Hamilton's current controlling circuit, "when the reference voltage is fixed, the current being sunk is limited to a maximum value determined by the reference voltage." *Id.* at 57 (citing Ex. 1006, Fig. 11-24b, 424–426). In particular, Petitioner asserts that "the sunk current ($I_{ref}$) flowing through transistor Q2 (i.e. a phase switch) is proportional to the reference voltage $V_{ref}$, and thus 'follows' the reference." *Id.* (citing Ex. 1003 ¶ 86 at 68). According to Petitioner and Dr. Shackle, those features disclose step 11a of the claim method. *Id.* (citing Ex. 1003 ¶ 86 at 69).

For limitation 11b, Petitioner asserts that "Chiang discloses turning off the phase switch of an upstream group, when the phase voltage of the next group downstream exceeds $V_d$ (i.e., the voltage across the corresponding current controlling unit, which is designed to have a value that is below 0.1v)." *Id.* at 58 (citing Ex. 1003 ¶ 86 at 69; Ex. 1004 ¶ 43). According to Petitioner and Dr. Shackle, "[t]hat occurs when the voltage at the input of the next group downstream reaches that group's $V_{th}+V_d$." *Id.* (citing Ex. 1003 ¶ 86 at 69) (emphasis omitted). Based on that functioning of Chiang and Hamilton's regulating function, Petitioner asserts and Dr. Shackle testifies that a skilled artisan "would understand that threshold levels $V_{th1}$ and $V_{th2}$ are chosen such that these voltages can drive the intended constant current through the corresponding phase switches," and "[w]hen the voltage $V_{th1}+V_{th2}+V_d$ is achieved, the phase switch for group 2 will turn on and conduct the intended constant current at the same time as the phase switch for group 1 turns off." *Id.* at 58–59 (citing Ex. 1003 ¶ 86 at 69). In other words, Petitioner asserts that "the phase switch of the upstream group is turned off as the phase current of the next group downstream comes

to its regulated value." *Id.* Therefore, according to Petitioner and Dr. Shackle,

> a POSITA would understand that, when the input voltage reaches a predetermined value sufficient to drive the next group downstream (e.g., $D_2$), the phase current flowing through next group downstream's phase switch (i.e., current controlling unit $I_2$) would rise to its regulated (i.e., constant) value as the phase switch for the upstream group (i.e., current controlling unit $I_1$) is turned off.

*Id.* at 59 (citing Ex. 1003 ¶ 86 at 70; Ex. 1004 ¶¶ 38–39).

Patent Owner argues that Petitioner has not established that the combination of Chiang and Hamilton discloses limitation 11b. PO Resp. 70. Specifically, Patent Owner asserts that "Chiang does not monitor the phase voltage of any phase switch, because Chiang only has a detector to detect the input voltage." *Id.* Patent Owner asserts that, "[f]or the same reason, Chiang does not disclose monitoring a phase current, and therefore cannot determine 'when the phase current of a next group downstream said upstream group reaches its regulated value." *Id.* (citing Ex. 2007 ¶¶ 130–131).

Patent Owner contends that Petitioner has not demonstrated otherwise by asserting that Chiang CCU $I_1$ will be disabled (turned off) and CCU $I_2$ will be enabled (turned on) "**when the input voltage reaches** $V_{th1}+V_{th2}+V_d$." *Id.* at 70–71 (citing Pet. 50). Patent Owner asserts that "the plain language of claim 11 requires that the phase switch of the upstream group is turned off **when** the downstream group reaches its regulated value." *Id.* (citing Ex. 2007 ¶¶ 132). According to Patent Owner, by focusing on input voltages, "Petitioner does not argue that reaching the downstream group's regulated value causes the upstream group to turn off." *Id.* (citing Pet. 59). Patent Owner asserts that the "turning on and off" described by

Petitioner is "caused by the detected input voltage and nothing else." *Id.* (citing Pet. 58).

In Petitioner's Reply, Petitioner asserts that "Chiang shows that it enables one CCU at a time, turning on the next CCU when it turns off the prior CCU." Pet. Reply 26. According to Petitioner, "Chiang discloses turning the downstream CCU on when it turns the upstream CCU off," and "[t]hat is all limitation 11b requires." *Id.*

Having considered the parties' arguments and evidence, we find that Patent Owner has the better position. In particular, we agree with Patent Owner that limitation 11b requires turning off the phase switch of the upstream group when the downstream group reaches its regulated value. *See* PO Resp. 70 (citing Ex. 2007 ¶¶ 132). Indeed, the claim recites, in part, "turning off the phase switch of the upstream group, *when* the phase current of a next group downstream said upstream group *reaches* its regulated value with the increase of the input voltage." Ex. 1001, 15:17–20 (emphases added). Thus, as Patent Owner asserts, that limitation "requires the prior phase switch to *remain on* until the phase current of the next phase switch 'reaches its regulated value.'" PO Sur-reply 22 (emphasis added). It is apparent that Petitioner has not demonstrated that requirement as it focuses on input voltages as opposed to monitoring the phase current of the upstream and downstream groups, alleges only that "Chiang discloses turning the downstream CCU on when it turns the upstream CCU off," and incorrectly asserts "[t]hat is all limitation 11b requires." Pet. Reply 26.

Accordingly, we determine that Petitioner has not demonstrated by a preponderance of the evidence that the combination of Chiang and Hamilton renders obvious claim 11.

*d) Claim 12*

Claim 12 depends from claim 11 and further recites, "wherein the reference of each phase switch is kept substantially constant." Ex. 1001, 15:21–22. To reach this limitation, Petitioner refers to Chiang's teaching that each of its CCUs "can be designed to be a *constant current source*." Pet. 60 (citing Ex. 1004 ¶ 39). According to Petitioner and Dr. Shackle, "[a] POSITA would understand that with Chiang's current controller units (i.e., phase switches) implemented using the control-and-feedback circuits shown in Hamilton's FIG. 11-24b, the way to keep the current constant would be to keep the reference voltage constant." *Id.* (Ex. 1003 ¶ 86 at 70).

For the same reasons discussed for claim 11, from which claim 12 depends, we determine that Petitioner has not established by a preponderance of the evidence that claim 12 is rendered obvious by the proposed combination of Chiang and Hamilton.

*e) Claim 18*

Claim 18 depends from claim 15 and recites, "The driver circuit of claim 15, wherein the phase switch comprises a N-Channel MOSFET, or a P-Channel MOSFET, or a NPN bipolar transistor, or a PNP bipolar transistor, or an Insulated Gate Bipolar Transistor (IGBT), or an analog switch, or a relay." Ex. 1001, 16:11–15. Petitioner asserts that the combination of Chiang and Hamilton discloses this limitation. Pet. 60. In particular, Petitioner asserts that a skilled artisan would have understood that "the symbol used for Q2 in Hamilton's Figure 11-24b shows that it is an NPN bipolar transistor, and that this transistor would be operating as Chiang's phase switch when Hamilton's FIG. 11-24b was used to implemented [sic] Chiang's current controlling units ($I_1$, $I_2$ . . . $I_n$)." *Id.* at 61 (citing 1003 ¶ 86 at 70–71). We find that showing to be persuasive.

Patent Owner's does not raise any separate arguments for claim 18. Based on our review of the record, we determine that Petitioner has established by a preponderance of the evidence that claim 18 is rendered obvious by the proposed combination of Chiang and Hamilton.

*f) Claim 21*

We addressed Petitioner's anticipation challenge of claim 21 above, in Section II.D.2.c., and determined that Petitioner demonstrated by a preponderance of the evidence that Chiang along anticipates the claim. Accordingly, we do not reach Petitioner's second challenge of claim 21 here based on obviousness over Chiang and Hamilton.

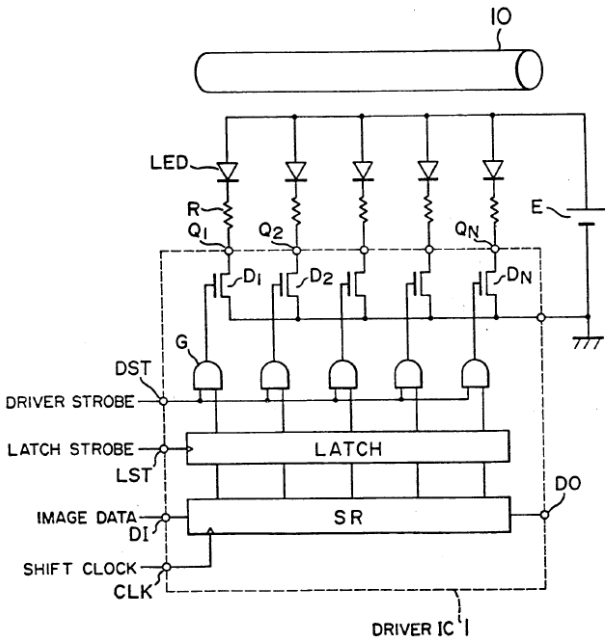
*G. Obviousness based upon Chiang and Hirane*

Petitioner asserts that claims 17 and 18 are rendered obvious over Chiang and Hirane. Pet. 62–68. Petitioner relies on Chiang as disclosing the elements of claim 15, from which claims 17 and 18 depend. *Id.* at 60–61, 65 (referring to its anticipation ground to assert that "Chiang discloses claim 15."). Petitioner relies on Hirane only to reach the additional limitations of the dependent claims. We focus on those limitations here.

*1. Hirane*

Hirane is directed to a "light-emitting element array device and a light-emitting element driver circuit employed as a light source for a recording operation in a printing apparatus of an electronic photography." Ex. 1007, 1:10–14. Hirane's Figure 10 is set forth below:

FIG. 10
PRIOR ART




*Id.*, Fig. 10. Hirane's Figure 10 is a circuit diagram showing an example of a "conventional light-emitting diode array driver circuit." *Id.* at 3:49–50.

*2. Discussion*

*a) Claim 17*

Claim 17 depends from claim 15 and recites, "The driver circuit of claim 15, wherein at least one of the phase switches is connected to a resistor in series." Ex. 1001, 16:9–10. Petitioner asserts that Hirane discloses this limitation because its driver circuit comprises a phase switch, i.e., a current controlling unit, which includes a transistor switch connected in series with a current limiting resistor. Pet. 66 (citing Ex. 1003 ¶ 96 at 79). Referring to Hirane's Figure 10, Petitioner asserts that Hirane's transistors $D_1$ to $D_n$ are switches that are connected to a resistor in series. *Id.* at 66–67 (citing 1003 ¶ 96 at 79). According to Petitioner, "Hirane shows a simple and conventional constant-current circuit design that a POSITA would be motivated to use for Chiang's current controlling unit because it is a simple,

robust, and functional approach." *Id.* at 65 (citing Ex. 1003 ¶ 94). Petitioner asserts that "using Hirane's switch plus current-limiting resistor design in Chiang would be predictable, as both Chiang's driver circuit and the conventional current-controller described in Hirane would continue to function exacly as described." *Id.* Petitioner asserts also that "a POSITA would reasonably expect to success in using Hirane's switch plus current-limiting resistor approach to implement Chiang's current controlling unit." *Id.* (citing Ex. 1003 ¶ 95).

Patent Owner contends that Petitioner fails to establish a motivation to combine Chiang and Hirane based on the differences between the references. PO Resp. 74–75. Specifically, Patent Owner contends that "Chiang is directed to a ci[r]cuit to drive LEDs with an AC input voltage that changes using analog circuitry in a lighting application with phase switches that sequentially turn on and off," whereas "Hirane is directed to an electronic photograph printer . . . with a DC input voltage that is constant with a digital input signal for a current reference with independently selectable switches." *Id.* at 75. According to Patent Owner, "a POSITA looking to implement a 'current controlling unit' in Chiang would not look to Hirane, which has no ability to control current in a circuit where the input voltage varies, as it does in Chiang." *Id.* (citing Ex. 2007 ¶¶ 138–139). Additionally, Patent Owner asserts that Petitioner fails to show whether or why a skilled artisan would have had a reasonable expectation of success in combining the teachings of Chiang and Hirane to achieve the invention of claim 17. *Id.* at 76.

In Petitioner's Reply, Petitioner asserts that Patent Owner parses the references too narrowly because Chiang discloses a CCU that can be embodied by any known device that turns current flow on/off, and Hirane discloses a simple version of such a CCU, comprising a MOSFET acting as

a switch in series with a current-limiting resistor. Pet. Reply 28–29. Petitioner asserts also that it relies on Hirane for no more than "a simple component of Hirane's 'prior art' LED device, which controls the current flow and on/off state of the LEDs using a MOSFET in series with a current-limiting resistor." *Id.* at 29 (citing Pet. 64–65).

In Patent Owner's Sur-reply, Patent Owner maintains that a skilled artisan would not have modified Chiang as Petitioner proposes. PO Sur-reply 23–25. In particular, Patent Owner asserts that "Hirane's current limiting resistors cause a constant current in each **individual path** for each LED, as each LED is individually controlled." *Id.* at 23 (citing Ex. 1007, 1:19–24; PO Resp. 74–75). According to Patent Owner, because "Chiang forms a **single path** for a constant current, as each LED group lights sequentially," there would be no reason to "control the current flowing through each LED group because the same total current always flows in Chiang's embodiment." *Id.* Patent Owner asserts that Petitioner's combination engages in hindsight bias and "fails to consider Hirane as a whole, instead importing only Hirane's current limiting resistors into Chiang's circuit," without explaining why. *Id.* at 24.

Based on our consideration of Petitioner's proposed combination, we agree with Patent Owner that Petitioner has not explained persuasively why a skilled artisan would have had reason to modify Chiang to incorporate Hirane's conventional constant-current circuit design. Petitioner's reason for the combination is that Hirane's design "is a simple, robust, and functional approach." Pet. 65 (citing Ex. 1003 ¶ 94). Petitioner and Dr. Shackle's conclusion, however, appears to be based only on the fact that Hirane's design was "conventional." Pet. 65; Ex. 1003 ¶ 94. But "[a] patent composed of several elements is not proved obvious merely by demonstrating that each element was, independently, known in the prior art." *KSR*, 550 U.S. at 401. Without more, we find that Petitioner has not established a sufficient motivation to modify Chiang as proposed, and agree with Patent Owner that Petitioner's rationale for modifying Chiang appears to be based on hindsight, i.e., merely to meet the limitation of claim 17.

Accordingly, we determine that Petitioner has not established by a preponderance of the evidence that claim 17 is rendered obvious by the proposed combination of Chiang and Hirane.

*b) Claim 18*

We addressed Petitioner's other obviousness challenge of claim 18 above, in Section II.F.2.b., and determined that Petitioner demonstrated by a preponderance of the evidence that the combination of Chiang and Hamilton renders this claim obvious. Accordingly, we do not reach Petitioner's second challenge of claim 18 here based on obviousness over Chiang and Hirane.

## III. PETITIONER'S MOTION TO STRIKE

Petitioner moves to exclude Exhibits 2009–2016. Mot. 1. Patent Owner filed those exhibits on June 11, 2021, along with, and in support of, its Patent Owner's Sur-reply. The exhibits are listed in Patent Owner's Updated Exhibit List, Paper 36. Petitioner timely objected to the exhibits on June 18, 2021. Paper 34. Petitioner asserts that it requested Patent Owner to withdraw the exhibits on the same day, which Patent Owner declined to do. On June 30, 2021, the Board authorized Petitioner to file a Motion to Strike.

Petitioner asserts that the Board should strike Exhibits 2009–2016 because the exhibits represent new evidence other than deposition transcripts of the cross-examination of any reply witness, and therefore are prohibited under 37 C.F.R. § 42.23(b) and the Consolidated Trial Practice Guide. Mot. 1–2. Patent Owner opposes the motion, asserting that it submitted Exhibits 2009–2016 not as new evidence, but as proper rebuttal evidence to what it deemed to be new arguments raised in Petitioner's Reply. Mot. Opp. 2–3. According to Patent Owner, the prejudice to Patent Owner in striking the exhibits would outweigh the prejudice to Petitioner in not striking them. *Id.* at 5.

Patent Owner's argument that the exhibits constitute "proper rebuttal evidence" is not well-taken. As Petitioner asserts, our Trial Rules and Consolidated Trial Practice Guide both prohibit submitting new evidence other than deposition transcripts of the cross-examination of any reply witness. *See* 37 C.F.R. § 42.23(b); Patent Trial and Appeal Board Consolidated Trial Practice Guide November 2019 ("CTPG"), 73–74 ("The sur-reply may not be accompanied by new evidence other than deposition transcripts of the cross-examination of any reply witness."). We find Patent Owner's assertion that Exhibits 2009–2016 were not submitted as "new

evidence" unpersuasive. The exhibits were not of record prior to Patent Owner filing them with its Sur-reply. Thus, they were submitted with the Sur-reply as new evidence. Patent Owner does not contend, nor do we find, that the exhibits comprise deposition transcripts of the cross-examination of any reply witness. Thus, the exhibits were improperly submitted, without authorization and in violation of our Rules and Guidance.

Patent Owner's assertion that striking the improperly submitted exhibits would be prejudicial is unavailing. Our Rules and Consolidated Trial Practice Guide are readily available and Patent Owner knew or should have known that submitting Exhibits 2009–2016 with its Sur-reply was prohibited. Moreover, our Consolidated Trial Practice Guide explains:

> If a party believes that a brief filed by the opposing party raises new issues, is accompanied by belatedly presented evidence, or otherwise exceeds the proper scope of reply or sur-reply, it may request authorization to file a motion to strike. Alternatively, a party may request authorization for further merits briefing, such as a surreply, to address the merits of any newly-raised arguments or evidence.

CTPG 80. Thus, the Board has identified appropriate ways for a party to address matters that it considers to be beyond the scope of a reply brief. Patent Owner had the opportunity to address the merits of any alleged new arguments in its Sur-reply, and it indeed did. However, further addressing those matters by submitting new evidence was not authorized by Board Rules or Guidance.

Further, we note that Patent Owner's reference to the Consolidated Trial Practice Guide for assertion that "motions to strike are an 'exceptional remedy' that is 'rarely granted," is misplaced. Mot. Opp. 3 (citing CTPG 80–81). The Consolidated Trial Practice Guide states that "striking the entirety or a portion of *a party's brief* is an exceptional remedy that the

Board expects will be granted rarely." CTPG 80 (emphasis added). Petitioner does not seek to strike the entirety or a portion of Patent Owner's Sur-reply. Rather, the motion is directed to the exhibits submitted with the Sur-reply only.

The facts here merit striking Exhibits 2009–2016, as it is beyond dispute that those exhibits are new evidence that was inappropriately submitted. *See* CTPG 81.

## IV. CONCLUSION

For the foregoing reasons, we conclude that Petitioner has shown by a preponderance of the evidence that claims 1, 10, 15, 18, and 21 of the '722 patent are unpatentable,[9] but has not shown by a preponderance of the evidence that claims 2, 3, 11, 12, 17, and 19 are unpatentable. Additionally, we grant Petitioner's Motion to Strike.

[9] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

In summary:

| Claims | 35 U.S.C. § | References | Claims Shown Unpatentable | Claims Not shown Unpatentable |
|---|---|---|---|---|
| 1–3, 10, 15, 19, 21 | 102/103(a)[10] | Chiang | 1, 10, 15, 21 | 2, 3, 19 |
| 2, 3 | 103(a) | Chiang, Leung | | 2, 3 |
| 11, 12, 18, 21 | 103(a)[11] | Chiang, Hamilton | 18 | 11, 12 |
| 17, 18 | 103(a)[12] | Chiang, Hirane | | 17 |
| **Overall Outcome** | | | 1, 10, 15, 18, 21 | 2, 3, 11, 12, 17, 19 |

## V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that based on a preponderance of the evidence claims 1, 10, 15, 18, and 21 of the '722 patent are unpatentable;

[10] As discussed in the analysis of the claims asserted for this ground, we have not reached the obviousness challenge asserted for claims 1, 15, and 21, as we have determined those claims are unpatentable based on the anticipation ground.

[11] As discussed in the analysis of the claims asserted for this ground, we have not reached the obviousness challenge asserted for claim 21, as we have determined that claim is unpatentable based on the anticipation ground.

[12] As discussed in the analysis of the claims asserted for this ground, we have not reached the obviousness challenge asserted for claim 18 over Chiang and Hirane, as we have determined that claim is unpatentable based on the obviousness challenge over Chiang and Hamilton.

FURTHER ORDERED that Petitioner has not shown that claims 2, 3, 11, 12, 17, and 19 are unpatentable based on Chiang, either alone or in combination with Leung, Hamilton, or Hirane;

FURTHER ORDERED Petitioner's Motion to Strike is *granted*; and

FURTHER ORDERED because this is a final written decision, the parties to this proceeding seeking judicial review of our Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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