

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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HOME DEPOT USA, INC.,  
Petitioner,

v.

LYNK LABS, INC.,  
Patent Owner.

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IPR2021-01367  
Patent 10,154,551 B2

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Before JON B. TORNQUIST, MONICA S. ULLAGADDI, and  
SCOTT RAEVSKY, *Administrative Patent Judges*.

TORNQUIST, *Administrative Patent Judge*.

JUDGMENT  
Final Written Decision  
Determining All Challenged Claims Unpatentable  
35 U.S.C. § 318(a)

## I. INTRODUCTION

### A. *Background and Summary*

Home Depot USA, Inc. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting an *inter partes* review of claims 1, 3, 4, 5, 7, and 8 (“Challenged Claims”) of U.S. Patent No. 10,154,551 B2 (Ex. 1001, “the ’551 patent”). Lynk Labs, Inc. (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 5. On February 18, 2022, we instituted review of all Challenged Claims of the ’551 patent. Paper 8 (“Institution Decision” or “Inst. Dec.”).

Patent Owner subsequently filed a Response (Paper 23, “PO Resp.”), to which Petitioner filed a Reply (Paper 29, “Pet. Reply”), and Patent Owner filed a Sur-Reply (Paper 35, “Sur-Reply”).

Petitioner relies, *inter alia*, upon the declaration and reply declaration of Dr. Dean Neikirk (Exs. 1002, 1049). Patent Owner submits a declaration from Dr. Eric Bretschneider (Ex. 2006).

An oral hearing was held on December 1, 2022, and a transcript of the hearing is included in the record (Paper 45, “Tr.”).

For the reasons that follow, we conclude that Petitioner has proven by a preponderance of the evidence that claims 1, 3, 4, 5, 7, and 8 of the ’551 patent are unpatentable (all Challenged Claims).

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

Petitioner identifies itself, The Home Depot Inc., and Home Depot Product Authority, LLC as the real parties in interest (“RPI”). Pet. 1. “In an abundance of caution, Petitioner also identifies as potential RPIs”: “Bel Air Lighting, Inc.; New Bright Technology; Cordelia Lighting; Elec-Tech Solid State Lighting (HK) Ltd.; Globe Electric; King of Fans, Inc.; Leedarson Lighting/Green Intelligence Co.; and Year Young Industrial Co.” *Id.*

Patent Owner identifies itself as the real party in interest. Paper 4, 1.

*C. Related Matters*

The parties identify the following district court proceeding as a related matter: *Lynk Labs, Inc. v. Home Depot USA, Inc., The Home Depot Inc., and Home Depot Product Authority, LLC*, No. 6:21-cv-00097 (W.D. Tex.), which has been transferred to the U.S. District Court for the Northern District of Georgia. Pet. 2; Paper 4, 1; Ex. 1042; Paper 40, 1 (noting that this case was stayed on March 31, 2022). Patent Owner also informs us that the '551 patent is currently at issue in *Lynk Labs, Inc. v. Samsung Electronics Co.*, No. 6:21-cv-02665 (N.D. Ill.). Paper 4, 1; Paper 40, 2.

*D. The '551 Patent*

The '551 patent is titled “AC Light Emitting Diode and AC LED Drive Methods and Apparatus” and “relates to alternating current (‘AC’) driven LEDs, LED circuits, and AC drive circuits and methods.” Ex. 1001, 2:24–26, code (54). The '551 patent explains that LEDs “are intrinsically DC devices that only pass current in one polarity and historically have been driven by DC voltage sources using resistors, current regulators, and voltage regulators to limit the voltage and current delivered to the LEDs.” *Id.* at 2:31–35. With proper considerations, however, the '551 patent reports that “LEDs may be driven more efficiently with AC than with DC drive schemes.” *Id.* at 2:38–39.

The '551 patent discloses various design features, including the use of a single bridge rectifier capable of rectifying a provided AC voltage, using a capacitor to smooth the AC waveform to reduce ripple and to protect the LEDs, and using various driver designs to provide a relatively constant or fixed voltage and frequency to LED circuits. *Id.* at 4:39–43, 4:49–51, 5:59–61.

With respect to the packaging of the LED lighting systems, the '551 patent indicates that in “certain applications” the systems can include “a heat sink, a reflective material, a lens for directing light, [and a] phosphor, nano-crystals or other light changing or enhancing substances.” *Id.* at 5:28–31.

*E. Illustrative Claims*

Petitioner challenges claims 1, 3, 4, 5, 7, and 8 of the '551 patent. Pet. 6–7. Claim 1 is illustrative of the challenged claims and is reproduced below:

1. A lighting system comprising:  
an LED circuit having at least one LED;  
a bridge rectifier;  
at least one capacitor;  
a driver connected to the bridge rectifier;  
the driver, bridge rectifier, at least one capacitor and at least one LED circuit all mounted on a reflective substrate,  
the driver providing rectified AC voltage and current to the LED circuit,  
the driver having an input of a first rectified AC voltage and a first frequency from a mains power source.

Ex. 1001, 18:52–63.

*F. Prior Art and Asserted Grounds*

Petitioner contends claims 1, 3, 4, 5, 7, and 8 are unpatentable on the following grounds (Pet. 6):

| Claims Challenged | 35 U.S.C. § <sup>1</sup> | Reference(s)/Basis                     |
|-------------------|--------------------------|----------------------------------------|
| 1, 5              | 103                      | Deese <sup>2</sup> , Kuo <sup>3</sup>  |
| 4, 8              | 103                      | Deese, Kuo, Hochstein418 <sup>4</sup>  |
| 1, 3, 5, 7        | 103                      | Lys <sup>5</sup> , Worley <sup>6</sup> |
| 1, 3, 5, 7        | 103                      | Hochstein168 <sup>7</sup> , Worley     |
| 4, 8              | 103                      | Lys, Worley, Hochstein418              |
| 4, 8              | 103                      | Hochstein168, Worley,<br>Hochstein418  |
| 3, 7              | 103                      | Deese, Kuo, Hochstein168               |

## II. ANALYSIS

### A. *Legal Standards*

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying

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<sup>1</sup> 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. Petitioner contends the first-to-file provisions of the AIA apply in this proceeding because at least two claims of the ’551 patent have an earliest effective filing date of October 30, 2017. Pet. 15. Patent Owner does not dispute Petitioner’s assertions. Accordingly, we apply the AIA versions of §§ 102 and 103. *See* 35 U.S.C. § 100(i)(2).

<sup>2</sup> US 5,457,450, issued October 10, 1995. Ex. 1006 (“Deese”).

<sup>3</sup> US 6,019,493, issued February 1, 2000. Ex. 1013 (“Kuo”).

<sup>4</sup> US 5,785,418, issued July 28, 1998. Ex. 1014 (“Hochstein418”).

<sup>5</sup> US Patent Publication No. US 2004/0212321 A1, published October 28, 2004. Ex. 1007 (“Lys”).

<sup>6</sup> US Patent Publication No. US 2003/0001657 A1, published January 2, 2003. Ex. 1008 (“Worley”).

<sup>7</sup> PCT/US97/10514, published December 31, 1997 (WO/97/50168). Ex. 1009 (“Hochstein168”).

factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) if in the record, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

*B. Level of Ordinary Skill in the Art*

In determining the level of skill in the art, we consider the type of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986).

Petitioner contends a person of ordinary skill in the art as of February 25, 2004, would have had “a Bachelor’s degree in electrical engineering, or similar technical field, with two years of relevant experience in the field of design and/or development of light-emitting diodes (LEDs) and circuits in the context of lighting control systems.” Pet. 14 (citing Ex. 1002 ¶ 24).

For purposes of this proceeding, Patent Owner does not dispute Petitioner’s definition of a person of ordinary skill in the art. PO Resp. 11.

Upon review of the prior art of record and Petitioner’s arguments, we adopt Petitioner’s undisputed definition of a person of ordinary skill in the art for purposes of this Final Written Decision, as it is consistent with the disclosures of the ’551 patent and the prior art of record.

*C. Claim Construction*

In this proceeding, the claims of the ’551 patent are construed “using 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. § 42.100(b) (2021). Under that standard, the words of a claim are generally given their “ordinary and customary meaning,” which is the meaning the term would have had to a person of ordinary skill at the time of the invention in the context of the entire patent including the specification. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc).

Petitioner proposes constructions for the terms “power factor correction circuitry” and “driver.” Pet. 16–18.

In the Institution Decision, we construed “driver” to mean “a program, circuitry, or device used to power other programs, circuits, or devices.” Inst. Dec. 14. We also asked the parties to address whether the term “mounted,” as used in independent claims 1 and 5, permits indirect contact between the various components and the reflective substrate. *Id.* at 32 n.11.

Patent Owner contends the Board’s adopted construction of “driver” is too broad, but because the arguments presented in Patent Owner’s Response to do not turn on a narrower construction of “driver,” it does not propose an alternate construction of the claim term. PO Resp. 12–13. Patent Owner does not address the scope of the term “mounted” in its Response or ask that any other claim terms be expressly construed.

Upon review of the parties’ arguments and supporting evidence, we adopt our previous construction of “driver” and determine that we need not construe any additional claim terms for purposes of this Final Written Decision. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”)). We note, however, that we do provide

additional explanation as to the scope of our previous construction of the term “driver” in our discussion of the combination of Deese and Kuo.

*D. Claims 1 and 5 over Deese and Kuo*

Petitioner contends the subject matter of claims 1 and 5 would have been obvious over the combined disclosures of Deese and Kuo. Pet. 19–36.

*1. Deese*

Deese discloses an LED traffic light system that uses voltage compensation circuits to allow operation “over a wide range of input power voltages, while generating sufficient light intensity to control traffic at a highway intersection.” Ex. 1006, code (57).

Figure 3 of Deese is reproduced below:

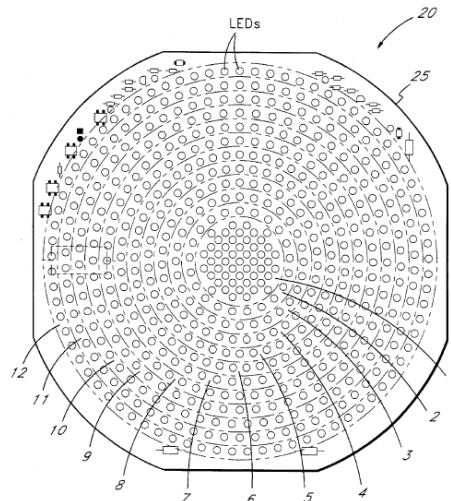


**FIG. 3**

Figure 3 “is a front view of a circuit board containing the LEDs and associated electronic circuitry of a first embodiment” of Deese and depicts “LED configuration and control circuitry 20.” *Id.* at 4:3–5, 4:55–56; *see also id.* at 5:25–28 (explaining that circuit board 25 supports the “associated electronic driver and control circuitry”). As shown in Figure 3, LED arrays 1–12 are arranged on circular printed circuit board 25 in a generally concentric pattern. *Id.* at 5:24–27, 5:36–37.

Figure 4 of Deese is reproduced below:

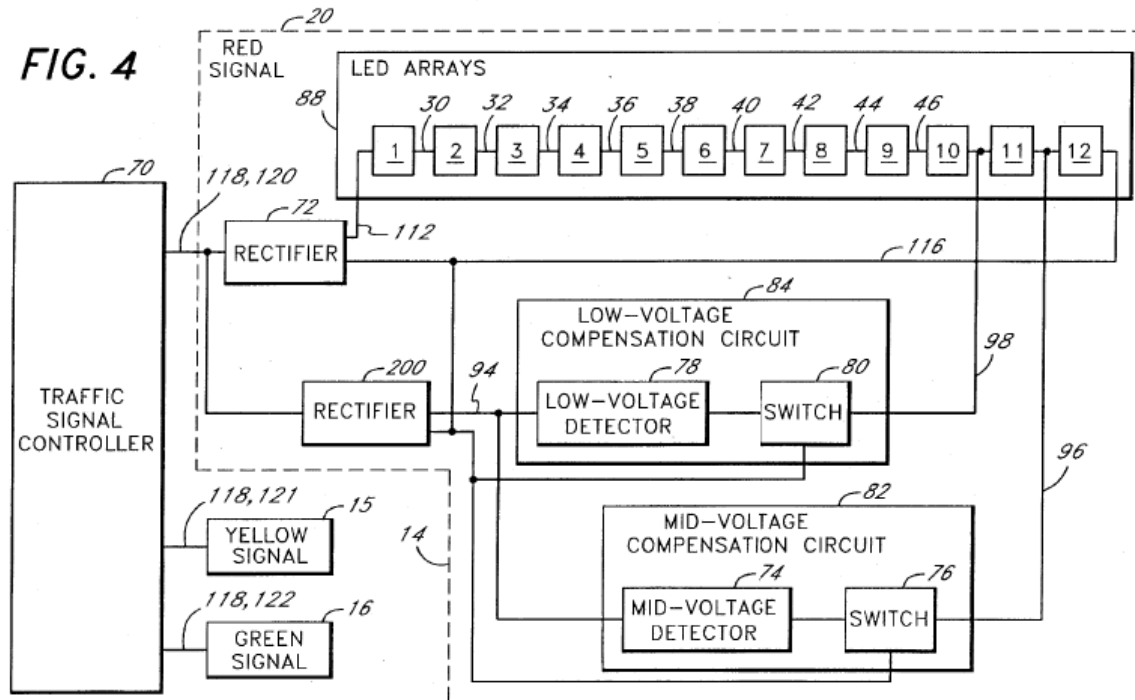


Figure 4 is a functional block diagram of a first embodiment of Deese. *Id.* at 4:6–7. In Figure 4, conventional traffic signal controller 70 selectively energizes red, yellow, and green traffic lights 14, 15, and 16. *Id.* at 5:48–50. As depicted in Figure 4, LED circuit 20 of the red LED traffic light is energized by line power delivered via AC power line 118 (alternately referred to in the reference as “line 118” and “line voltage power line 118”) and return signal line 120. *Id.* at 5:50–52.

AC power lines 118 and 120 are connected to rectifier 72, which converts the AC power delivered by traffic signal controller 70 to DC power (or rectified AC voltage). *Id.* at 5:64–66. DC power is then provided to LED arrays 1–12, which each comprise seven strings of series-connected LEDs that are connected in parallel. *Id.* at 5:66–7:3, 7:30–59.

As shown in Figure 4, line voltage power line 118 and line voltage return line 120 are also connected to rectifier 200, which provides reference

voltage 94 to mid-voltage detector 74 and low-voltage detector 78. *Id.* at 7:34–41. When reference voltage 94 is greater than the intermediate voltage threshold (approximately 107 volts), mid-voltage detector 74 of mid-voltage compensation circuit 82 operates to open switch 76 connected between line 96 and DC return line 116. *Id.* at 7:45–51. If reference voltage 94 is less than the intermediate voltage threshold, switch 76 is closed, effectively shorting line 96 to DC return line 116 and removing LED array 12 from the circuit. *Id.* at 7:53–60.

Low voltage compensation circuit 84 operates in a similar manner to mid-voltage compensation circuit 82, but utilizes a lower voltage threshold of approximately 96 volts. *Id.* at 7:63–67. If reference voltage 94 is less than the low voltage threshold, switch 80 shorts line 98 to DC return line 116, effectively removing LED arrays 11 and 12 from the circuit. *Id.* at 8:9–18.

Figure 5 of Deese is reproduced below:

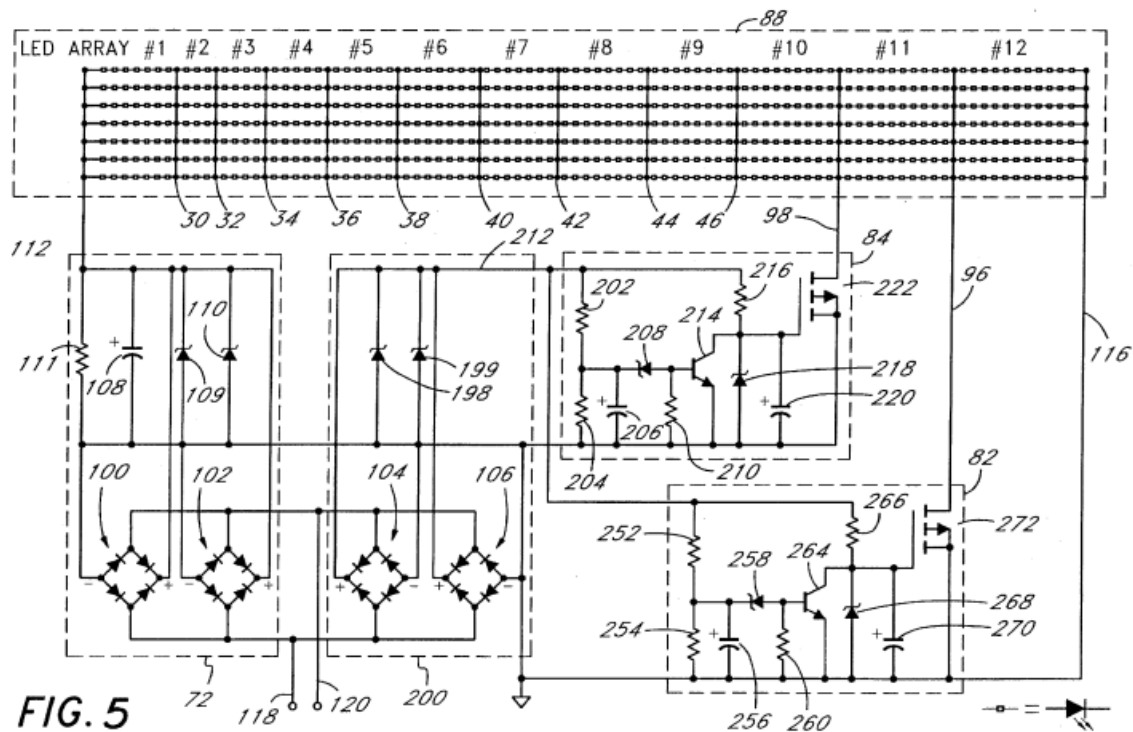


Figure 5 is a schematic diagram of the first embodiment of Deese. *Id.* at 4:11–12. In Figure 5, AC power lines 118 and 120 are connected to rectifier 72, which comprises a pair of “dual in-line package (DIP) bridge rectifiers 100 and 102, a resistor 111, a capacitor 108, and a pair of zener diodes 109 and 110.” *Id.* at 9:52–55. Regulated DC voltage on line 112 is connected to the positive terminal of LED array 1, and DC return line 116 is connected to the negative terminal of LED array 12. *Id.* at 10:4–9. Deese explains that bridge rectifiers 100 and 102 convert AC to DC voltage, capacitor 108 and resistor 111 provide voltage filtering for the voltage across regulated DC power line 112 and DC return line 116, and zener diodes 109 and 110 protect LED circuit 20 from damage caused by a potential lightning strike. *Id.* at 10:10–27.

Second rectifier 200 comprises a pair of DIP bridge rectifiers 104 and 106 and a pair of zener diodes 198 and 199. *Id.* at 10:30–33. Second rectifier 200 is “substantially independent” of first rectifier 72, such that noise produced by the LEDs does not affect the regulated DC reference voltage on line 212 that is provided to voltage compensation circuits 82 and 84. *Id.* at 10:50–54. As discussed above with respect to Figure 4, mid-voltage and low voltage compensation circuits 82 and 84, respectively, are designed to remove LEDs 11 and/or 12 from the circuit, depending on the regulated DC voltage on line 112. *Id.* at 10:61–12:11.

## 2. Kuo

Kuo discloses a high efficiency light that utilizes LEDs and different lenses to amplify the intensity of light from the LEDs. Ex. 1013, 1:6–9. Figure 2 of Kuo is reproduced below:

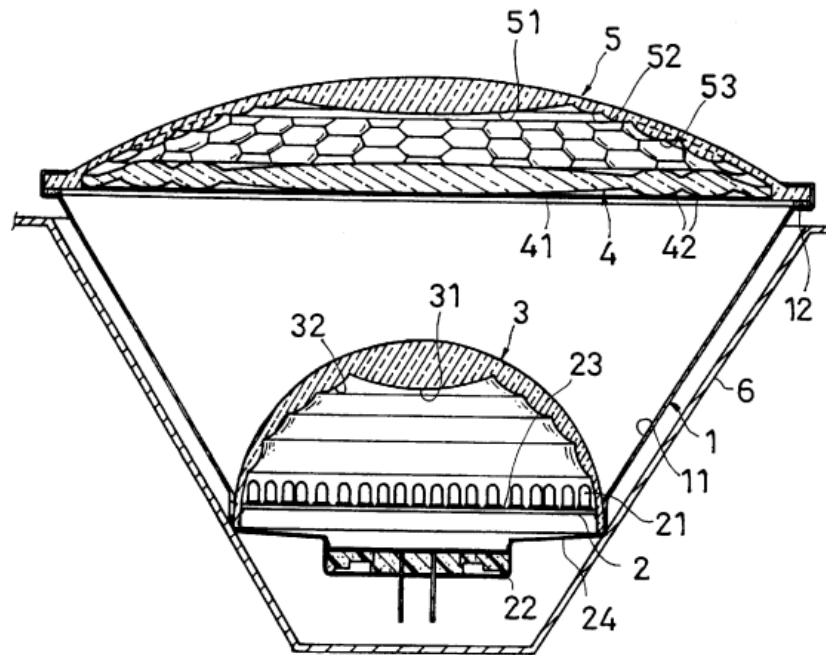


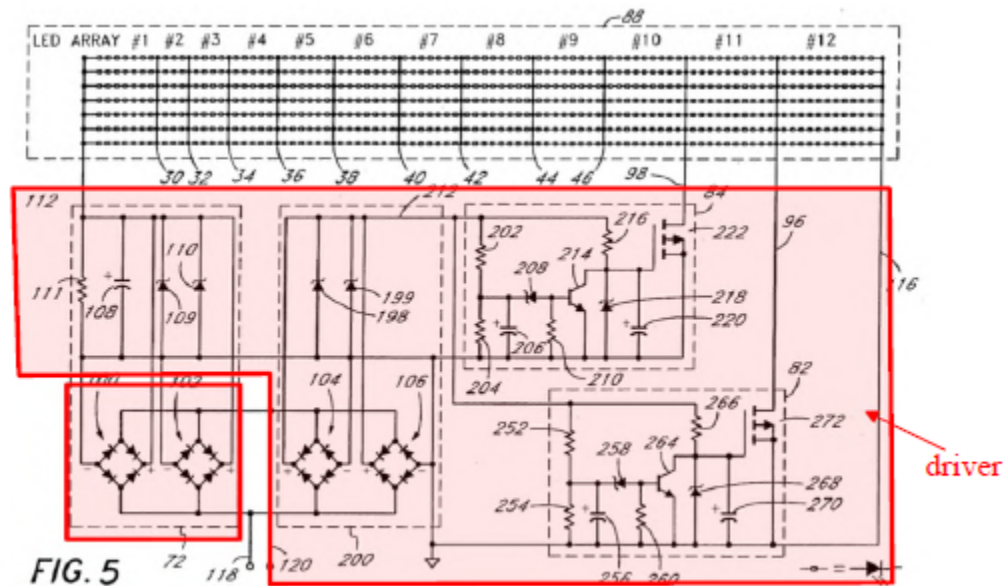
FIG. 2

Figure 2 is a sectional assembly view of the high efficiency light of Kuo. *Id.* at 2:15–16. As shown in Figure 2, lamp shade 1, having a light reflecting surface 11, is mounted in signal light bracket 6. *Id.* at 2:30–35. Circuit board 2 has LEDs 21 on its top surface and power save control circuit 22 mounted on its bottom surface. *Id.* at 2:37–39. The top side 23 of circuit board 2 on which the LEDs are installed is coated with a light reflecting substance. *Id.* at 3:1–3.

### 3. Analysis

Petitioner contends that Deese discloses most of the limitations of independent claims 1 and 5, including (1) a “lighting system” comprising “an LED circuit” “having at least one LED” (LED arrays 1–12) (Pet. 23–25 (citing Ex. 1006, 4:3–12, 5:24–7:21, 6:31–52, Figs 3–5); (2) a bridge rectifier (bridge rectifiers 100 and 102) (*id.* at 25–26 (citing Ex. 1006, 5:46–

6:3, 7:33–8:18, 9:52–10:60, Figs 4–5)); and (3) at least one capacitor (capacitors 108, 206, 220, 256, and 270) (*id.* at 26–27 (citing Ex. 1006, 4:11–12, 9:52–11:45, Fig. 5)). Petitioner further contends that Deese expressly describes Figure 3 (depicting printed circuit board 25) as including a driver and provides an annotated version of Figure 5, reproduced below, that identifies the circuitry that Petitioner considers to be the driver. *Id.* at 28–29.



The figure above is an annotated version of Figure 5 showing Petitioner's identification of the bridge rectifier (red box, lower left corner) connected to the driver of Deese (red box, both above and to the right of the identified bridge rectifier). *Id.* at 29–30. Petitioner contends that the driver of Deese provides rectified AC voltage and current to the LED circuit and that the input of the driver is a first rectified AC voltage having a first frequency from a mains power source. *Id.* at 32–33.

Petitioner argues that the driver, bridge rectifier, capacitor, and LED circuits of Deese are all mounted on printed circuit board 25 and that this circuit board would reflect some light. *Id.* at 30–31. And, to the extent that

printed circuit board 25 is not considered to be reflective, Petitioner contends Kuo discloses coating a circuit board containing LEDs with a reflecting substance. *Id.* at 31 (citing Ex. 1013, 3:1–3).

With respect to the unique limitations of independent claim 5, Petitioner contends that a person of ordinary skill in the art would have understood that the driver of Deese has an input of a first rectified AC voltage and current from the bridge rectifier and provides a second rectified AC voltage and current to the LED circuit. *Id.* at 34 (citing Ex. 1002 ¶ 73). Petitioner further contends that capacitor 108 of Deese is connected to all the LEDs in LED array 88 and serves to smooth the rectified AC voltage waveform from rectifiers 100 and 102. *Id.* at 35 (citing Ex. 1006, 10:10–30, Fig. 5).

Petitioner contends one of ordinary skill in the art would have sought to combine the disclosures of Deese and Kuo because Deese, Kuo, and the '551 patent are all in the same field of LED lighting systems, and because one of ordinary skill in the art “would have recognized that Deese’s goal of generating sufficient light intensity and brightness” would have been furthered by using Kuo’s reflective coating on the top layer of circuit board 25. *Id.* at 20–22.

Patent Owner contends Petitioner’s arguments are not persuasive because: (1) Kuo is not analogous art, and (2) Deese does not teach or suggest the “driver” of claim 1. PO Resp. 14–25. We address these arguments in turn.

*a) Analogous Art*

To resolve whether art is analogous we must determine “(1) whether the art is from the same field of endeavor, regardless of the problem addressed and, (2) if the references are not within the field of the inventor’s

endeavor, whether the reference still is reasonably pertinent to the problem with which the inventor is involved.” *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004).

In the Institution Decision we preliminarily determined that the field of endeavor of the ’551 patent is “LED lighting systems.” Inst. Dec. 22–23; Pet. 20 (Petitioner asserting that the ’551 patent is in “the field of endeavor of LED lighting systems”). In their subsequent briefing, neither party disputes that the field of endeavor is “LED lighting systems.” PO Resp. 23 (“The field of endeavor is LED lighting systems.”); Pet. Reply 14.

Patent Owner contends Kuo is not in the field of LED lighting systems because it “is only concerned with the traffic light assembly (that is, the physical structure that houses the bulb) rather than the LED lighting system.” PO Resp. 23 (citing Ex. 1013, Figs. 1–3; Ex. 2006 ¶¶ 110–115). And, although the ’551 patent discusses applications in “general lighting” and “signs,” Patent Owner contends these applications are directed towards lighting systems that provide illumination, and not traffic signals that are used primarily to signal. *Id.* at 23–24. In addition, Patent Owner contends the ’551 patent is concerned with power efficiency, a subject that it contends Kuo has nothing to do with. *Id.* at 24.

Kuo discloses a “high efficiency light” that uses LEDs to emit light, as well as different lenses to amplify the intensity of the light emitted from the LEDs. *See* Ex. 1013, 1:6–9. Although Kuo focuses primarily on using its light as a traffic signal, Kuo is not limited to this embodiment and broadly claims “[a] high efficiency light.” *Id.* at 3:14–4:23 (*Compare* claim 1 directed to “[a] high efficiency light,” *with* claim 2 directed to use of the light of claim 1 “as a signal light”). Thus, we find that Kuo is in the same field of endeavor as the ’551 patent, i.e., LED lighting systems.

Even if Kuo was not in the same field of endeavor, though, we find that Kuo meets the “reasonably pertinent” prong of the analogous art test. *KSR* instructs that “familiar items may have obvious uses beyond their primary purposes, and a person of ordinary skill in the art often will be able to fit the teachings of multiple patents together like pieces of a puzzle.” *KSR*, 550 U.S. 398, 402 (2007). Given this instruction, the Federal Circuit has explained that when considering whether prior art is reasonably pertinent we must look beyond the primary problem the inventor was seeking to solve. *See Wyers v. Master Lock Co.*, 616 F.3d 1231, 1238 (Fed. Cir. 2010) (explaining that in analyzing whether the prior art is reasonably pertinent we must construe the scope of analogous art “broadly”); *see also Donner Tech., LLC v. Pro Stage Gear, LLC*, 979 F.3d 1353, 1360 (Fed. Cir. 2020) (explaining that the “reasonably pertinent” analysis must look to all of the problems to which the claimed invention relates, and must not be analyzed so narrowly as to effectively collapse the “field-of-endeavor and reasonable-pertinence inquiries”).

Here, although the ’551 patent is primarily focused on ways to efficiently drive LEDs using AC power, the ’551 patent is also concerned with methods of assembling an LED lighting system, including the use of: an insulating substrate, a heat sink, a reflective material on which to mount the LEDs, a lens for directing light, and a light changing or enhancing substance(s). Ex. 1001, 5:6–31, code (54) (noting that the ’551 patent is directed to both AC LED drive methods and an apparatus). Kuo expressly discloses the design of a housing that uses a lens and a light reflecting surface to maximize the light obtained from LEDs. These disclosures are reasonably pertinent to at least one problem the ’551 patent was intended to solve, e.g., what techniques and materials should be used to construct an

efficient LED lighting system or apparatus. Thus, we find that Kuo is analogous art to the '551 patent under both prongs of the analogous art test.

#### 4. *Driver of Deese*

Patent Owner contends the circuit of Deese, identified in the Petition as a “driver,” is not “a program, circuitry, or device used to power other programs, circuits, or devices.” PO Resp. 15. Patent Owner reasons that none of the circuit elements identified in the Petition, “including low compensation voltage circuit 84, mid-voltage compensation circuit 82, [and] rectifier 200,” serve to “power LED array 88 or any other elements of Deese’s LED circuit.” *Id.* (citing Ex. 2006 ¶¶ 86–97). Patent Owner further reasons that the resistor, capacitor, and the two diodes in rectifier 72 do not “power” other circuit components as none of these components “are used to apply additional voltage to the LED circuit in a manner that would power any other circuit component.” *Id.* at 21 (citing Ex. 2006 ¶ 96).

Deese expressly discloses that circular printed circuit board 25 “supports 595 LEDs and their associated electronic driver and control circuitry.” Ex. 1006, 5:25–28; Pet. 27 (“Figure 3 is expressly described as including a driver.”). Thus, there is no doubt that Deese includes a driver. The primary question that remains is which components of Deese should or could be considered a “driver,” as that term is used in independent claims 1 and 5 of the '551 patent.

As noted in the Institution Decision, our construction of “driver” is broad, and does not require that the identified driver generate power (i.e., current and voltage) or apply additional voltage, only that the identified device or circuit be used to provide or direct power to the LEDs.

Inst. Dec. 12–14, 23; Ex. 1049 ¶¶ 28–38. Petitioner and Dr. Neikirk persuasively explain why the elements of Deese identified in the Petition

serve to both provide power to the LEDs and condition this power.<sup>8</sup>

Ex. 1049 ¶¶ 28–38; Pet. 29; Pet. Reply 9–10. Thus, we find that Deese discloses the driver recited in claim 1. Ex. 1002 ¶¶ 56–57; Ex. 1049 ¶¶ 28–38.

Claim 5 requires that the driver have an input of a first rectified AC voltage and current and provide a second rectified AC voltage and current to the LED circuit. Ex. 1001, 19:10–13. Dr. Neikirk provides persuasive, uncontested testimony, that the components identified as the driver in the Petition, when considered as a whole, accept an input of a first rectified AC voltage and current (from the bridge rectifier) and output a second rectified AC voltage and current to the LEDs. Ex. 1002 ¶¶ 64–65, 72–73. Thus, we find that Deese teaches or suggests the driver recited in claim 5 of the '551 patent.

## 5. *Conclusion*

For the reasons set forth above, and upon review of the record as a whole, we determine that Petitioner persuasively identifies where Deese and Kuo teach or suggest every limitation of independent claims 1 and 5 of the '551 patent. Petitioner also provides a reasoned explanation as to why one of ordinary skill in the art would have combined the teachings of Deese and Kuo to arrive at the subject matter of claims 1 and 5 with a reasonable expectation of success. Accordingly, Petitioner demonstrates by a

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<sup>8</sup> In its Preliminary Response, Patent Owner asserted that the term “driver” should be construed as “a component that conditions a power input and provides a power output to an LED circuit.” Paper 5, 19. We agree with Petitioner that the capacitor and resistor of Deese condition a power input and provide a power output to an LED circuit. Tr. 8:21–9:4.

preponderance of the evidence that claims 1 and 5 would have been obvious over Deese and Kuo.

*E. Claims 4 and 8 over Deese, Kuo, and Hochstein418*

Claims 4 and 8 depend from claims 1 and 5, respectively, and further require that “the substrate is a heat sinking material.” Ex. 1001, 19:1–2, 19:21–22. Petitioner contends claims 4 and 8 would have been obvious over the combined disclosures of Deese, Kuo, and Hochstein418. Pet. 36–40.

*1. Hochstein418*

Hochstein418 discloses a thermally protected LED array. Ex. 1014, code (54). Hochstein418 notes that LED traffic signals have an expected life of at least five to seven years, yet newly developed LED traffic signals are exhibiting useful service lives that are much shorter than predicted, sometimes as short as two years or less. *Id.* at 1:16–22. According to Hochstein418, “[r]ecent experiments with a wide variety of L.E.D.s suggests an exponential relationship between life versus operating temperature.” *Id.* at 1:13–45. To address the problem of operating temperature within LED systems, Hochstein418 discloses an apparatus that “provides a directionally selective heat sink and dissipator which enhances dissipation of heat from an LED array to the surrounding air, but retards heat flow into the LED array from high temperature sources such as solar heated air or from direct solar radiation.” *Id.* at 4:24–29.

Figure 2 of Hochstein418 is reproduced below:

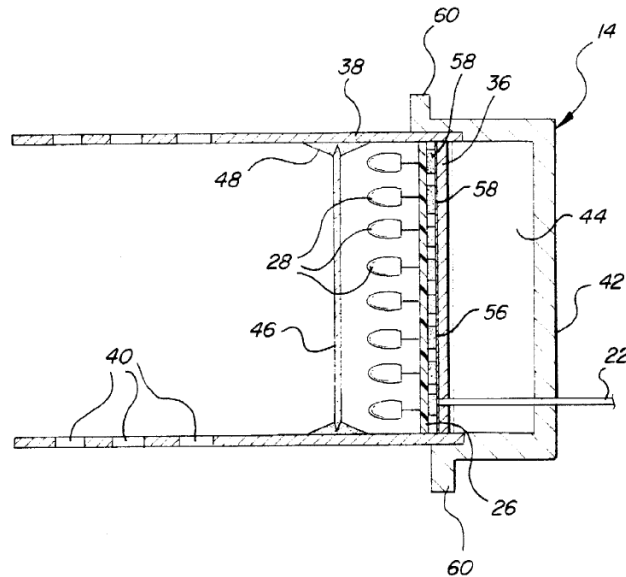


**FIG-2**

Figure 2 is a cross section view of a preferred embodiment of the invention, and includes electrically insulating circuit board 26 having opposed first and second surfaces, with light emitting diodes 28 having leads 30 and 32 (positive and negative) mounted on the first surface of circuit board 26. *Id.* at 5:12–16. “A heat sink includes base 36 overlying the back surface of the circuit board and a shell 38 extending forwardly from the base 36 in front of the light emitting diodes 28 for conducting heat to the light emitting side of the assembly.” *Id.* at 5:21–25. Casing 42 surrounds base 36, and insulating material 44 is disposed between base 36 and casing 42 to limit heat transfer to the heat sink from the outside of casing 42, i.e., from sources other than LEDs 28. *Id.* at 5:35–39.

Hochstein418 explains that in this embodiment, “instead of trying to reject heat to the air within the traffic signal housing, heat is directly rejected to outside air.” *Id.* at 7:25–27. This is accomplished by conducting heat from the base or bottom 36 along the side walls of shell 38 to outside ambient air. *Id.* at 7:22–25.

## 2. *Analysis*

Petitioner contends that Hochstein418 expressly discloses the need for an improved heat sink for LED lighting systems and that performance (lifetime) can be further improved by adding a “thermally insulating material” to the heat sink. Pet. 37–38. Given these disclosures, Petitioner contends one of ordinary skill in the art would have sought to add another heat sink to the substrate in Deese in order to improve heat dissipation. *Id.* at 38.

Patent Owner contends “[t]here is a difference between the ‘substrate is a heat sinking material’ as claimed and adding a heat sink to the substrate as suggested by Hochstein 418.” PO Resp. 25 (citing Ex. 2006 ¶¶ 120–125). Patent Owner further contends that one of ordinary skill in the art would not have sought to implement the heat sink of Hochstein418 in Deese and Kuo because in the ’551 patent “heat is dissipated through the substrate into the surroundings of the LED circuit,” whereas “the Hochstein418 reference is explicitly concerned with preventing heat from external sources from affecting the LEDs.” *Id.* at 25–28 (Ex. 2006 ¶¶ 121–122; Ex. 1014, 9:33–34). Patent Owner further contends that “[u]sing a thermally insulated heat sink as in Hochstein418 would prevent heat from the LEDs from dissipating through the substrate into the surrounding LED circuit, which goes against the purpose of forming the substrate from a heat sinking material.” *Id.* at 27 (citing Ex. 2006 ¶ 124).

Petitioner contends Patent Owner “is simply wrong about Hochstein418.” Pet. Reply 15. Petitioner argues that the fact that a heat sink material is different than the insulating material is irrelevant because a substrate may be composed of multiple layers, as is expressly disclosed in the ’551 patent. *Id.* at 15–16 (Ex. 1001, 16:61–17:1; Ex. 1049 ¶¶ 48–49).

Petitioner further argues that there can be no dispute that Hochstein418 expressly teaches mounting LEDs onto a heat sinking material that transfers heat generated by the LEDs to the ambient environment. *Id.* at 16.

Petitioner contends Patent Owner’s attempt to distinguish Hochstein418 based on whether heat is dissipated versus being kept away from the heat sink is a “red herring” because (1) there is no directionality requirement in the claims, and (2) even if a directionality were required in the claims, there is no dispute that the heat sinking material of Hochstein418 dissipates heat from the LED array. *Id.* at 17 (citing Ex. 1014, 8:23–26).

In its Sur-Reply, Patent Owner repeats its argument that the heat sink material of the ’551 patent is designed to dissipate heat to the ambient environment. Sur-Reply 7. And, “because Hochstein418’s heat sink is insulated from the ambient environment,” Patent Owner contends “the alleged heat sink cannot dissipate heat from the LEDs.” *Id.* (citing Ex. 1054, 24:7–25:8).

We discern no limitation in the ’551 patent that would preclude the substrate from being composed of multiple layers. Indeed, as noted by Petitioner, the ’551 patent does not appear to disclose any embodiment wherein the reflective substrate is also a heat sinking layer. Pet. Reply 5–6, 15–16. Thus, we agree with Petitioner and Dr. Neikirk that a substrate that is composed of, among other things, a first reflective layer and a second heat sinking layer would be considered a substrate that is both reflective and a heat sink. *Id.* at 6–8, 15–16; Ex. 1049 ¶ 48.

As noted by Patent Owner, an insulative material is used in Hochstein418 to prevent heat from high temperature sources—such as solar heated air or direct solar radiation—from entering the heat sink. Ex. 1014, 4:21–29. But in addition to this insulating material, a thermally-conductive

path is provided in Hochstein418 (base 36 and shell 38) to allow heat *from the LED array* to be dissipated to the surrounding air. *Id.* at 4:24–26, 5:21–27 (explaining that base 36 and shell 38 work in concert to conduct “heat from the LEDs of the back side of the circuit board to the ambient air within the sun hood 24”), 7:15–27 (noting that “instead of trying to reject heat to the air within the traffic signal housing, heat is directly rejected to outside air”). Thus, we credit the testimony of Dr. Niekerk that Hochstein418 discloses a substrate that includes a heat sinking material that would serve to remove heat from the LEDs. Ex. 1002 ¶¶ 78–85. We also find persuasive Petitioner’s argument that one of ordinary skill in the art would have sought to use the heat sink of Hochstein418 in order to remove heat from the LEDs of Deese and Kuo and potentially increase their service life. Pet. 37; Ex. 1014, 1:43–45 (“Recent experiments with a wide variety of L.E.D.s suggests an exponential relationship of life versus operating temperature.”).

### 3. Conclusion

Upon review of the parties’ arguments and supporting evidence, we determine that Petitioner persuasively identifies where Deese, Kuo, and Hochstein418 teach or suggest every limitation of claims 4 and 8 of the ’551 patent. Petitioner also provides a reasoned explanation supported by rational underpinnings as to why one of ordinary skill in the art would have combined these references to arrive at the subject matter of claims 4 and 8 with a reasonable expectation of success. Accordingly, Petitioner demonstrates by a preponderance of the evidence that claims 4 and 8 would have been obvious over Deese, Kuo, and Hochstein418.

#### F. Claims 3 and 7 over Deese, Kuo, and Hochstein168

Claim 3 depends from claim 1, and claim 7 depends from independent claim 5, and both require that “the driver further includes power factor

correction circuitry.” Ex. 1001, 18:66–67, 19:19–20. Petitioner contends the subject matter of claims 3 and 7 would have been obvious over the combined disclosures of Deese, Kuo, and Hochstein168. Pet. 76–77.

*1. Hochstein168*

Hochstein168 discloses an apparatus “for supplying regulated voltage d.c. electrical power to an LED array.” Ex. 1009, code (57). In particular, Hochstein168 discloses “a power supply for operating light emitting diode array traffic signals.” *Id.* at 1:4–6.

Hochstein168 explains that although LED arrays have become common, the power supplies in these systems “exhibit very poor power factors<sup>9</sup> . . . and may be disallowed by power utilities.” *Id.* at 1:7–13, 2:3–6. To overcome the problem of poor power factors for LED lighting systems, Hochstein168 discloses the use of a power factor correcting circuit. *Id.* at 5:2–16.

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<sup>9</sup> “Power Factor gives a measurement of how effective the real power utilization of the system is. It is a measure of the distortion on the line voltage and the line current and the phase shift between them.” Ex. 1041, 535. “Power factor is defined as the cosine of the angle between voltage and current in an ac circuit” (*id.*), or “the ratio of the real power (P) to apparent power (S)” (Ex. 1016, 217).

Figure 5 of Hochstein168 is reproduced below:

**FIG - 5**

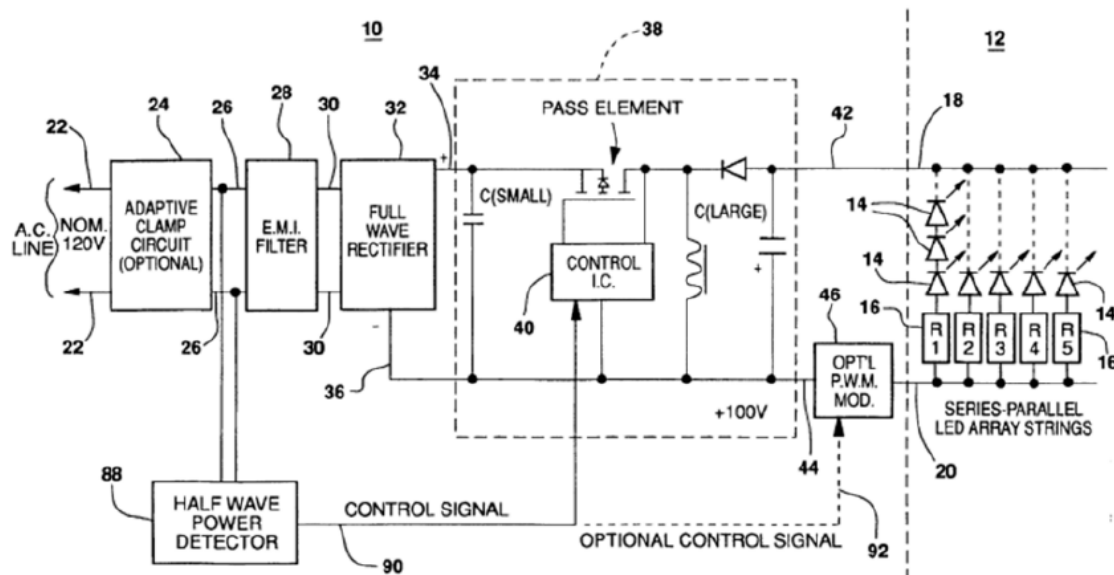


Figure 5 is “a schematic diagram of a regulated voltage, switchmode power supply for LED signals in accordance with the present invention.” *Id.* at 7:7–8. In this embodiment, “LED array 12 includes a plurality of strings of series connected LEDs 14 with a ballasting resistor 16 (R1, R2, R3, R4, R5, . . .) connected in each string.” *Id.* at 8:10–12. “The strings are connected in parallel between a first input line 18 and a second input line 20 of the LED array 12.” *Id.* at 8:12–13.

“Power supply 10 has a pair of power input lines 22 for connection to a source (not shown) of a.c. power, such as main power lines at a nominal 120 volts a.c.” *Id.* at 8:14–16. Adaptive clamp circuit 24 is connected to electromagnetic interference (E.M.I) filter 28, which is connected via a pair of filter output lines 30 to an input of a rectifier means 32, which converts the incoming a.c. power to a pulsing d.c. power generated on positive output line 34 and negative output line 36. *Id.* at 8:30–9:4. Converter 38 includes a power factor correction circuit controller 40. *Id.* at 9:10–14. A positive

polarity output line 42 is connected to the first input line 18 of LED array 12 and negative polarity output line 44 is connected to the second input line 20 of LED array 12 “through an optional pulse width modulated (P.W.M.) modulator 46.” *Id.* at 9:21–26.

## 2. *The Parties’ Arguments*

Petitioner contends that Hochstein168 discloses the use of power correction circuitry in the form of “power factor correction (P.F.C.) integrated circuit (I.C.) controller 40.” Pet. 76–77 (citing Ex. 1009, 9:10–11). Petitioner further contends that one of ordinary skill in the art would have sought to include power factor correction circuitry in the driver of Deese in order to improve the power efficiency of the system, as disclosed in Hochstein168. *Id.*

Patent Owner contends Petitioner’s arguments with respect to claims 3 and 7 fail because they do not remedy the deficiencies discussed above with respect to the “driver” of independent claims 1 and 5. PO Resp. 34.

## 3. *Analysis*

As discussed above, we find no deficiencies in Petitioner’s arguments with respect to independent claims 1 and 5 over Deese and Kuo. With respect to the subject matter of claims 3 and 7, Petitioner persuasively demonstrates that Hochstein168 discloses power factor correction circuitry and persuasively explains that one of ordinary skill in the art would have sought to include this type of circuitry in the device of Deese and Kuo in order to improve the power efficiency of the LED lighting system. Pet. 76–78; Ex. 1009, 3:7–26 (noting the energy savings when power factors approach unity). Accordingly, Petitioner demonstrates by a preponderance

of the evidence that claims 3 and 7 would have been obvious over Deese, Kuo, and Hochstein168.

*G. Grounds based on Lys and/or Worley*

Petitioner presents grounds that are based on the disclosures of Lys (Lys and Worley; Lys, Worley, and Hochstein418) and Worley (Hochstein168 and Worley; Hochstein168, Worley, and Hochstein 418). As we determine all challenged claims are unpatentable in view of the Deese-based grounds discussed above, we do not address Petitioner’s grounds based on Lys and/or Worley. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding a petitioner “is entitled to a final written decision addressing all of the claims it has challenged”); *Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App’x 984, 990 (Fed. Cir. Apr. 30, 2020) (non-precedential) (recognizing that the “Board need not address issues that are not necessary to the resolution of the proceeding” and, thus, agreeing that the Board has “discretion to decline to decide additional instituted grounds once the petitioner has prevailed on all its challenged claims”).

### III. CONCLUSION<sup>10</sup>

In summary:

| <b>Claims</b> | <b>35<br/>U.S.C.<br/>§</b> | <b>Reference(s)/Basis<sup>11</sup></b> | <b>Claims<br/>Shown<br/>Unpatentable</b> | <b>Claims Not<br/>Shown<br/>Unpatentable</b> |
|---------------|----------------------------|----------------------------------------|------------------------------------------|----------------------------------------------|
| 1, 5          | 103                        | Deese, Kuo                             | 1, 5                                     |                                              |
| 4, 8          | 103                        | Deese, Kuo, Hochstein418               | 4, 8                                     |                                              |
| 1, 3, 5,<br>7 | 103                        | Lys, Worley                            |                                          |                                              |
| 1, 3, 5,<br>7 | 103                        | Hochstein168, Worley                   |                                          |                                              |
| 4, 8          | 103                        | Lys, Worley, Hochstein418              |                                          |                                              |
| 4, 8          | 103                        | Hochstein168, Worley,<br>Hochstein418  |                                          |                                              |
| 3, 7          | 103                        | Deese, Kuo, Hochstein168               | 3, 7                                     |                                              |
|               |                            | <b>Overall Outcome</b>                 | <b>1, 3, 4, 5, 7, 8</b>                  |                                              |

### VI. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1, 3, 4, 5, 7, and 8 of the '551 patent  
are unpatentable; and

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<sup>10</sup> 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).

<sup>11</sup> For the reasons set forth above, we do not address Petitioner's grounds that include Lys or Worley.

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

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