

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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IPR2020-00410  
Patent 10,134,967 B2

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

ROESEL, *Administrative Patent Judge*.

JUDGMENT  
Final Written Decision  
Determining All Challenged Claims Unpatentable  
Granting Patent Owner's Motion to Amend  
*35 U.S.C. § 318(a)*

## I. INTRODUCTION

### A. Background and Summary

Satco Products, Inc. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) seeking *inter partes* review of claims 1–16 (“the challenged claims”) of U.S. Patent No. 10,134,967 B2 (Ex. 1001, “the ’967 Patent”). Seoul Semiconductor Co., Ltd. (“Patent Owner”) filed a Preliminary Response. Paper 7. We instituted an *inter partes* review. Paper 8 (“Inst. Dec.”).

After institution, Patent Owner filed a Response (Paper 17, “PO Resp.”), Petitioner filed a Reply (Paper 25, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 37, “PO Sur-reply”). Patent Owner also filed a contingent Motion to Amend (Paper 19, “PO MTA”), and Petitioner filed an Opposition (Paper 26, “Pet. MTA Opp.”). We issued Preliminary Guidance. Paper 32 (“Prelim. Guidance”). Petitioner filed a Reply to the Preliminary Guidance (Paper 41, “Pet. MTA Reply”), and Patent Owner filed a Sur-reply to the Preliminary Guidance (Paper 43, “PO MTA Sur-reply”). An oral hearing was held on April 11, 2021, and a transcript of the hearing is included in the record. Paper 46.

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–16 of the ’967 Patent are unpatentable and that Petitioner has not shown by a preponderance of the evidence that proposed substitute claims 17–22 are unpatentable.

*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. as the real party in interest. Paper 4, 1 (Mandatory Notice).

*C. Related Matters*

The parties identify the following district court actions in which Patent Owner is asserting the '967 Patent:

*Seoul Semiconductor Co., Ltd. v. Satco Products, Inc.*, No. 2:19-cv-04951 (E.D.N.Y.);

*Seoul Semiconductor Co., Ltd. v. The Factory Depot Advantages, Inc.*, No. 2-19-cv-05065 (C.D. Cal.); and

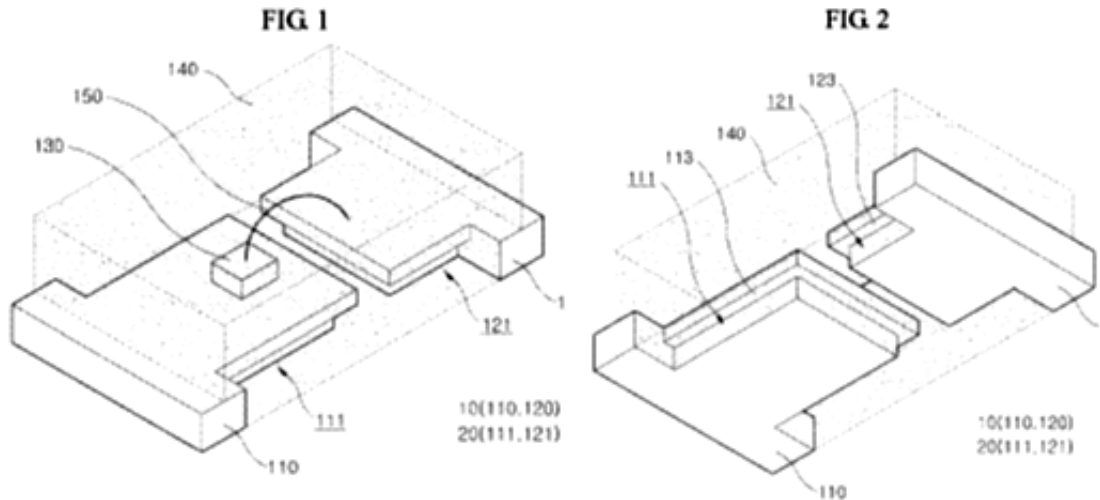
*Seoul Semiconductor Co., Ltd. v. Healthe, Inc.*, No. 6-19-cv-02264 (M.D. Fla.).

Pet. 1; Paper 4, 1–2.

Patent Owner identifies Application No. 16/953,254, filed November 19, 2020, seeking a broadening reissue of the '967 Patent. Paper 18 (Updated Mandatory Notices). In view of this *inter partes* review, prosecution of the reissue application was suspended for a period of six months effective December 3, 2020.

*D. The '967 Patent (Ex. 1001)*

The '967 Patent discloses a light emitting device “configured to enhance adhesive force between a lead frame and a molding unit by forming a fixing space through the lead frame and integrally forming the molding unit on the top surface of the lead frame and in the fixing space.” Ex. 1001, 1:26–31. An embodiment is shown in Figures 1 and 2, which are reproduced below.



Figures 1 and 2 show top and bottom views, respectively, of a light emitting device having lead frame units 10 formed of metal, including first and second lead frames 110 and 120 having fixing spaces 20, including outer fixing holes 111 and 121. Ex. 1001, 2:43–46, 3:1–27, 3:37–47. Stepped portions 113 and 123 are formed on sidewalls of outer fixing holes 111 and 121. *Id.* at 3:48–52. Light emitting diode chip 130 is mounted on first lead frame 110 and connected to second lead frame 120 by wire 150. *Id.* at 3:67–4:3. Molding unit 140 is formed on a top surface of lead frame units 10 to protect light emitting diode chip 130. *Id.* at 3:10–12.

The '967 Patent describes the function of fixing spaces 20 as follows:

When the molding unit 140 is formed on top surfaces of the first and second lead frames 110 and 120, molding resin for the molding unit 140 is filled in the fixing spaces 20 such that the molding resin applied on the top surfaces of the first and second lead frames 110 and 120 and the molding resin filled in the fixing spaces 20 can be monolithic. That is, the fixing spaces 20 function to allow the molding unit 140 to be securely adhered to the top surfaces of the lead frame units 10.

Ex. 1001, 3:28–36.

Therefore, the molding unit 140 formed on the top surfaces of the first and second lead frames 110 and 120 extends to the outer

fixing holes 111 and 121 and is hooked on the stepped portions 113 and 123. Therefore, the separation of the molding unit 140 from the first and second lead frames 110 and 120 can be physically prevented.

*Id.* at 3:52–58.

*E. Illustrative Claim*

The '967 Patent includes 16 claims, all of which are challenged in the Petition. Claims 1 and 9 are independent. Claim 1 is reproduced below:

1. A light-emitting device, comprising:

a first lead frame and a second lead frame spaced apart from each other, the first and second lead frames each comprising a top surface, an opposing bottom surface, and sidewalls arranged between the top surface and the bottom surface; and

a light-emitting diode chip disposed on the top surface of the first or second lead frame, wherein:

each of the first lead frame and the second lead frame comprises a first undercut sidewall, a second undercut sidewall, and a third undercut sidewall that at least partially define a fixing space, the fixing space being formed by the undercut sidewalls of the first lead frame and the second lead frame,

the top surfaces of the first and second lead frames are substantially flat, and

the first lead frame and the second lead frame face each other in a horizontal direction such that the first undercut sidewall of the first lead frame faces the first undercut sidewall of the second lead frame,

the second undercut sidewall and the third undercut sidewall of the first lead frame are parallel to each other and perpendicular to the first undercut sidewall of the first lead frame, and

the second undercut sidewall and the third undercut sidewall of the second lead frame are parallel to each other and perpendicular to the first undercut sidewall of the second lead frame.

Ex. 1001, 6:28–55.

Claim 9 contains the same limitations as claim 1 and an additional limitation that recites: “the top surface of the first and second lead frames are on substantially the same plane.” Ex. 1001, 8:9–10; *see* Pet. 51–52 (chart comparing claims 1 and 9).

*F. Asserted Grounds*

Petitioner asserts the following grounds of unpatentability:

| Claim(s) Challenged | 35 U.S.C. §         | Reference(s)/Basis |
|---------------------|---------------------|--------------------|
| 1–16                | 102(b) <sup>1</sup> | Lee <sup>2</sup>   |
| 1–16                | 103(a)              | Lee                |

*G. Testimonial Evidence*

Petitioner filed a Declaration of P. Morgan Pattison, Ph.D. (Ex. 1003) with the Petition and a second declaration of Dr. Pattison (Ex. 1024) with the Reply. Patent Owner cross-examined Dr. Pattison twice and filed transcripts of the depositions as Exhibits 2023 and 2024. Petitioner filed a Declaration of Michael R. Krames, Ph.D. (Ex. 1025) with its Opposition to the Motion to Amend. Patent Owner cross-examined Dr. Krames and filed a transcript of the deposition as Exhibit 2027.

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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. Because the ’967 Patent asserts the benefit of applications filed before this date, the pre-AIA version of §§ 102 and 103 apply. Ex. 1001, code (63).

<sup>2</sup> Ex. 1004, US 2006/0043401 A1, published March 2, 2006 (“Lee”).

Patent Owner filed a Declaration of Dr. Jung Han (Ex. 2001) with the Preliminary Response and a second declaration of Dr. Han (Ex. 2008) with the Response. Petitioner cross-examined Dr. Han and filed a transcript of the deposition as Exhibit 1022. Patent Owner also filed a Declaration of Monica Hansen, Ph.D. (Ex. 2009) with the Response. Petitioner cross-examined Dr. Hansen and filed a transcript of the deposition as Exhibit 1023.

## II. ANALYSIS

### A. *Legal Standards*

“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) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)); *see also* 37 C.F.R. § 42.104(b) (requiring a petition for *inter partes* review to identify how the challenged claim is to be construed and where each element of the claim is found in the prior art patents or printed publications relied upon).

A patent claim is unpatentable under 35 U.S.C. § 103 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. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved based on underlying 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) when presented, objective evidence of nonobviousness, i.e., secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).<sup>3</sup>

Additionally, the obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (*citing In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”)). Furthermore, Petitioner does not satisfy its burden of proving obviousness by employing “mere conclusory statements,” but “must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

*B. Level of Ordinary Skill in the Art*

Relying on Dr. Pattison’s testimony, Petitioner provides the following contention regarding a person of ordinary skill in the art (“POSITA”):

A POSITA in the field of the ’967 patent at the time of the effective filing date would have would have [*sic*] been knowledgeable regarding conventional LED designs, LED fabrication techniques, LED package designs, including surface mount LED designs, and LED packaging techniques. A POSITA would have had at least a master’s degree in a relevant field (e.g., chemical engineering, materials engineering, or electrical engineering), as well as at least 2 years of experience in LED fabrication and packaging. Alternatively, a POSITA would have an equivalent combination of education and experience, such as a Ph.D. and some practical work involving LED fabrication and packaging. A person with less education but more relevant

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<sup>3</sup> Neither party presents evidence of secondary considerations of nonobviousness.

practical experience, depending on the nature of that experience and degree of exposure to LED package fabrication and design, could also qualify as a POSITA in the field of the '967 patent.

Pet. 16–17 (citing Ex. 1003 ¶¶ 20–25). Patent Owner does not contest Petitioner's contention regarding the level of ordinary skill in the art. All of the parties' declarants have applied the above definition of a POSITA, which we applied in the Institution Decision. Inst. Dec. 8; Ex. 1003 ¶¶ 24, 25 (Dr. Pattison); Ex. 1025 ¶ 22 (Dr. Krames); Ex. 2001 ¶ 22 (Dr. Han); Ex. 2009 ¶ 17 (Dr. Hansen).

In our analysis below, we apply Petitioner's uncontested definition of a POSITA, which is supported by Dr. Pattison's testimony (Ex. 1003 ¶¶ 24, 25) and is consistent with the scope and content of the '967 Patent and the asserted prior art.

### *C. Claim Construction*

In an *inter partes* review, we apply the same claim construction standard as would be used by a district court to construe a claim in a civil action involving the validity or infringement of a patent. 37 C.F.R. § 42.100(b) (2020). Under that standard, claim terms are given their ordinary and customary meaning, as would have been understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history of record. *Id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–19 (Fed. Cir. 2005) (en banc); *Thorner v. Sony Comput. Entm't Am. LLC*, 669 F.3d 1362, 1365–66 (Fed. Cir. 2012).

Below we discuss the meaning of two claim terms addressed by the parties. We determine that no other claim term requires express construction for purposes of resolving the parties' disputes. *Vivid Techs., Inc. v. Am. Sci.*

*& Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (holding that “only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy”); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (applying *Vivid Techs.* in the context of *inter partes* review).

1. “*lead frame*”

In the Institution Decision, we applied Patent Owner’s construction for “lead frame” as the “metal portion of a device package that makes electrical connections between a die and other parts of the circuitry.” Inst. Dec. 12 (hereinafter “our preliminary construction”).

Patent Owner agrees with our preliminary construction (PO Resp. 75–76), and Petitioner does not oppose it. *See* Pet. Reply 1–7 (addressing claim construction, but not for “lead frame”); *see also* Pet. 17 (“Petitioner does not believe any specific constructions are required at this time . . .”). Because neither party challenges our preliminary construction, we apply the same construction as set forth in the Institution Decision and support that construction with essentially the same analysis, which follows.

Under applicable law, the ordinary meaning of a claim term “may be determined by reviewing various sources, such as the claims themselves, the specification, the prosecution history, dictionaries, and any other relevant evidence.” *Ruckus Wireless, Inc. v. Innovative Wireless Sols., LLC*, 824 F.3d 999, 1002–03 (Fed. Cir. 2016). We determine that our construction is the ordinary and accustomed meaning of “lead frame,” as evidenced by the Specification of the ’967 Patent, two technical dictionary definitions, and Petitioner’s extrinsic evidence.

The '967 Patent does not define a “lead frame,” but it discloses embodiments that are consistent with Patent Owner’s construction. First, the Specification describes a lead frame “formed of metal.” Ex. 1001, 3:18–20 (in Figure 1, “lead frame unit 10 [is] formed of metal”). There is no suggestion in the '967 Patent that a “lead frame” can be made of anything other than metal. Second, the Specification suggests that a lead frame provides an electrical connection to a light emitting diode chip. When describing the Figure 1 embodiment, for example, the '967 Patent states, “[t]he light emitting diode chip 130 is mounted on the first lead frame 110 and electrically connected to the second lead frame 120 by a wire 150.” *Id.* at 3:67–4:3. Similarly, when describing the Figure 8 embodiment, the '967 Patent states, “the light emitting diode chip 130 is electrically connected to the first and second lead frames 110 and 120 by respective wires 150a and 150b.” *Id.* at 5:39–42. These passages suggest that the lead frame provides electrical connection between the light emitting diode chip and other device circuitry, e.g., on a printed circuit board. *See id.* at 1:44–47 (“Recently, . . . the LEDs have been made in a surface mount device type so that they can be directly mounted on a printed circuit board.”).

Our construction is also directly supported by definitions from two different technical dictionaries. Ex. 2003<sup>4</sup> (“lead frame . . . [t]he metal part of a solid-state device package that achieves electrical connection between the die and other parts of the system of which the IC is a component . . .”); Ex. 2004<sup>5</sup> (“lead frame[:] the metallic portion of the device package that

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<sup>4</sup> Graf, *Modern Dictionary of Electronics* (7th ed. 1999), page 417.

<sup>5</sup> LaPlante, *Electrical Engineering Dictionary* (E-Book), ISBN, 0-8493-2170-0 (2000), page 408.

makes electrical connections from the die to the other circuitry”); *see* PO Resp. 76 (relying on technical dictionaries, Exs. 2003, 2004). We find that these dictionary definitions are consistent with the descriptions of a “lead frame” in the ’967 Patent. It is therefore proper to rely upon these definitions as evidence of the meaning of “lead frame” to a person of ordinary skill in the art. *Phillips*, 415 at 1322–23 (Judges may “rely on dictionary definitions when construing claim terms, so long as the dictionary definition does not contradict any definition found in or ascertained by a reading of the patent documents.”).

Our construction is further supported by additional extrinsic evidence submitted by Petitioner and relied upon by Dr. Pattison. Ex. 1008,<sup>6</sup> 1:16–17 (stating “[c]onventional lead frames are usually produced from a metal sheet by die-punching”); Ex. 1009,<sup>7</sup> 1:18–20 (“A conventional lead frame is formed on a metal strip such as plate, sheet, etc. by punching or etching tile metal strip to have predetermined patterns.”); *see* Ex. 1003 ¶¶ 42, 43 (Dr. Pattison quoting passages that include these excerpts from Exhibits 1008 and 1009). This evidence supports our determination that a “lead frame” is a “metal portion.”

Accordingly, for these reasons and consistent with the definition provided in the Institution Decision, we construe the term “lead frame” as the “metal portion of a device package that makes electrical connections between a die and other parts of the circuitry.”

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<sup>6</sup> US 5,221,428, issued June 22, 1993.

<sup>7</sup> US 5,406,119, issued April 11, 1995.

2. “*undercut sidewalls*”

In the Institution Decision, we construed “undercut sidewalls” as “sidewalls having a structure consistent with material having been cut away from the underside so as to leave an overhanging portion in relief.” Inst. Dec. 16.

Patent Owner agrees with our construction. PO Resp. 76–80. Petitioner does not expressly oppose our construction for “undercut sidewalls,” but presents other arguments about the meaning of the term. Pet. Reply 1–7. After considering both parties’ arguments and evidence, we apply the same construction as set forth in the Institution Decision. Our reasoning follows.

Petitioner contends that “undercut sidewalls” does not impose a processing requirement and means that the sidewalls are “indented from an upper portion of the lead frame to leave overhanging portions.” Pet. 14–15, 17, 58–61; Pet. Reply 4. Petitioner contends that this definition is consistent with the ’967 Patent Specification, dictionary definitions cited by the Examiner and Patent Owner during prosecution, common usage in industry, and Patent Owner’s proposed district court construction. Pet. 15, 17; Pet. Reply 1–2 (citing Ex. 1016, 29). Petitioner argues that the term “undercut sidewalls” does not require a one-piece structure and that sidewalls can be undercut, even if they are formed from multiple layers. Pet. Reply 2–7.

Patent Owner agrees that the term “undercut sidewalls” does not have a processing requirement. PO Resp. 77. The parties’ agreement does not, however, mean that the term “undercut” should not be given patentable weight. It is well-established that patentability of a product claim must be “determined based on the product itself,” not the process by which the product is made. *In re Thorpe*, 777 F.2d 695, 697 (Fed. Cir. 1985). Even

so, a process-type limitation is not always disregarded when determining patentability of a product claim. “If the process limitation connotes specific structure and may be considered a structural limitation, however, that structure should be considered.” *In re Nordt Dev. Co., LLC*, 881 F.3d 1371, 1374–75 (Fed. Cir. 2018) (holding that claim term, “injection molded,” “is structural and should have been afforded weight when assessing patentability”). As our reviewing court has explained, “words of limitation that can connote with equal force a structural characteristic of the product or a process of manufacture are commonly and by default interpreted in their structural sense, unless the patentee has demonstrated otherwise.” *Nordt*, 881 F.3d at 1375–76 (quoting *3M Innovative Props. Co. v. Avery Dennison Corp.*, 350 F.3d 1365, 1371–72 (Fed. Cir. 2003)).

We find that, in the context of claim 1, the term “undercut” connotes a structural characteristic in much the same way as the term “injection molded” connoted a structure in *Nordt*. 881 F.3d at 1375. Petitioner does not disagree that “undercut” has a structural meaning and attempts to capture that meaning with the definition, “indented from an upper portion of the lead frame to leave overhanging portions.” Pet. 15, 17; Pet. Reply 4. In our view, however, Petitioner’s definition is inconsistent with the meaning of “undercut” in the prosecution history.

The Examiner’s reasons for allowance rely on the requirement for three “undercut” sidewalls to distinguish claim 1 from the prior art. Ex. 1002, 25. When examining the claims, the Examiner assumed that “‘undercut sidewalls’ are sidewalls that have ‘cut away material from so as to leave a portion overhanging, as in carving or sculpture.’” *Id.* at 78 (April 30, 2018 Office Action, citing <http://www.dictionary.com/browse/undercut?s=t>). Applicant provided a similar definition: “‘Undercut is

defined to mean ‘to cut away material from the underside of (an object) so as to leave an overhanging portion in relief.’” *Id.* at 60 (June 19, 2018 Response, citing <https://www.merriam-webster.com/dictionary/undercut>); *see also id.* at 62 (quoting same definition).

Both parties rely on these definitions from the prosecution history. Pet. 9, 11, 15, 17; PO Resp. 78; Pet. Reply 5–6. We find that Petitioner’s proposed construction differs substantially from the definitions provided by the applicant and the Examiner. Instead of specifying that material has been cut away from an object, Petitioner characterizes the sidewalls as simply “indented” from an upper portion of a lead frame. Pet. 15, 17; Pet. Reply 4. For this reason, we do not apply Petitioner’s construction for “undercut sidewalls.”

To define “undercut sidewalls” in its structural sense, we rely on the definitions of “undercut” from the prosecution history. According to these definitions, “undercut” means that material has been cut away from the underside of an object. Ex. 1002, 60, 62, 78. We also rely on applicant’s prosecution history remarks, which rely on Figures 1 and 2 of the ’967 Patent as support for the claim recitation of “undercut sidewalls.” *Id.* at 60 (“Applicants submit that FIGS. 1 and 2 below show sidewalls that cut away material from the underside of an object so as to leave an overhanging portion in relief.”); *id.* at 136 (“FIGS. 1 and 2 clearly disclose 3 undercut sidewalls where the face of each sidewall has a clear undercut/step/ledge.”); *see* Pet. Reply 5–6 (relying on these prosecution history remarks).

We find that the prosecution history and the dictionary definitions relied upon by the applicant and the Examiner are the most helpful intrinsic evidence for construing “undercut sidewalls.” Nevertheless, we also consider the surrounding claim language and the Specification, which shed

light on the meaning of “undercut sidewalls” by describing and depicting a “fixing space” that is defined by undercut sidewalls.

Claims 1 and 9 recite that three undercut sidewalls “at least partially define a fixing space.” Ex. 1001, 6:38–39, 7:21–22. The Specification describes “three inset sidewalls that at least partially define a fixing space, the fixing space undercutting at least one of the first lead frame and second lead frame.” *Id.* at 2:10–11. The “fixing space” is depicted in Figures 1, 2, 4, 5, and 7–9 of the ’967 Patent, which show fixing spaces 20 defined either by stepped portions 113, 117, 123, and 127 on the sidewalls or by inclined surfaces 118, 119, 128, and 129. *Id.* at 3:48–52, 4:58–63, 5:55–63. The Specification includes following description of “fixing spaces”:

In the modified example of FIG. 9, a shape of the fixing spaces is varied. That is, instead of forming the stepped portions 113, 117, 123, and 127 on the sidewalls of the outer and inner fixing holes 111, 121, 115, and 125 so that the lower area can be greater than the upper area, the inner sidewalls of the outer and inner fixing holes 111, 121, 115, and 125 are provided with inclined surfaces 118, 119, 128, and 129 such that the areas of the outer and inner fixing holes 111, 121, 115, and 125 gradually increase downward.

*Id.* at 5:55–63.

We find that the “fixing spaces” depicted in Figures 1, 2, 4, 5, and 7–9 and described in the foregoing passage have a shape that is consistent with material having been cut away from the underside so as to leave an overhanging portion in relief, as set forth in our claim construction for “undercut sidewalls.” By providing examples of fixing spaces defined by undercut sidewalls that fall within the scope of our claim construction, the Specification provides support for that construction.

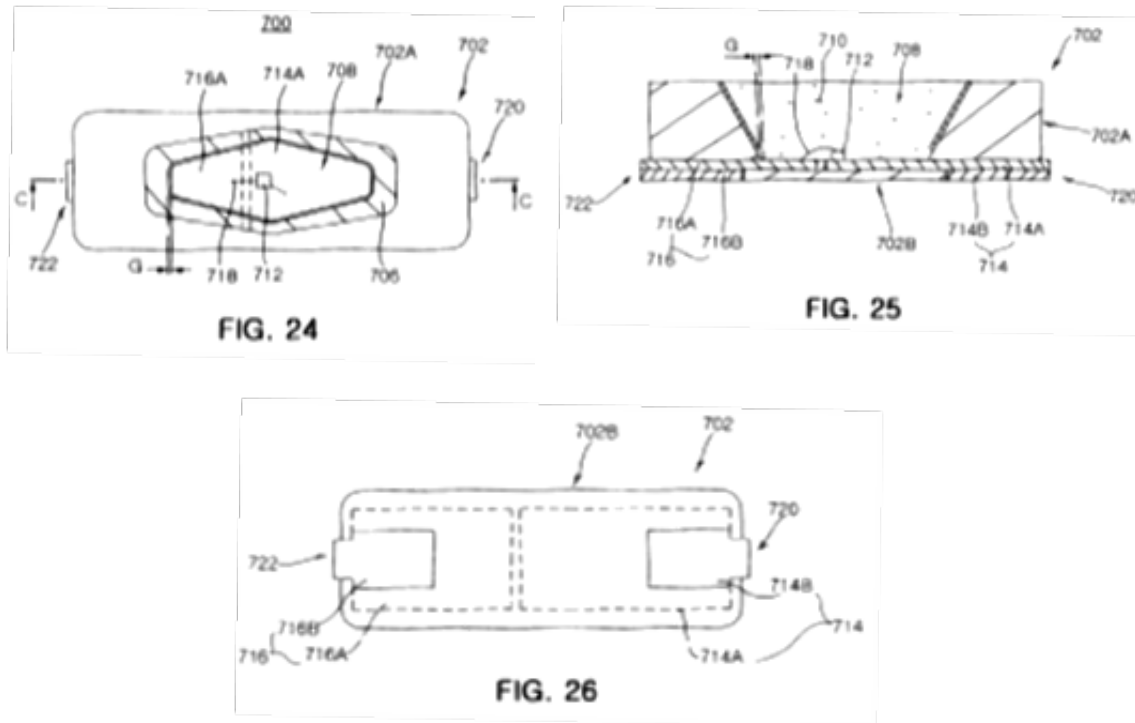
Although agreeing with our construction, Patent Owner argues that “the use of the term ‘undercut’ indicates an integral structure.” PO Resp. 79. Petitioner argues the opposite—that “the term ‘undercut’ does not require a one-piece lead frame.” Pet. Reply 7. Because this dispute is relevant only to Petitioner’s anticipation ground, not the obviousness ground, it is not necessary for us to resolve this dispute for purposes of determining whether Petitioner has met its burden to show that the challenged claims are unpatentable.

Accordingly, for these reasons and consistent with the definition provided in the Institution Decision, we construe “undercut sidewalls” as “sidewalls having a structure consistent with material having been cut away from the underside so as to leave an overhanging portion in relief.”

*D. Overview of Lee (Ex. 1004)*

Lee discloses a high power light emitting diode (“LED”) package, including first and second sheet metal members that are each electrically connected to an LED chip and a package body formed with resin that partially surrounds the sheet metal members and has a recess that receives the LED chip and is filled with a transparent sealant. Ex. 1004, codes (54), (57), ¶ 15; *see also id.* at Figs. 3–6, ¶¶ 64–71 (showing and describing a first embodiment). Lee discloses that the first sheet metal member has a bent shape that “is formed by etching or press working of a source sheet metal.” *Id.* ¶¶ 28, 29; *see also id.* ¶ 70 (sheet metal members may be formed by cutting and punching a source sheet metal plate and selectively reducing thickness through etching).

Petitioner relies on Lee’s seventh embodiment shown in Figures 24–26, which are reproduced below.



Lee Figures 24–26 show an LED package, with a plan view in Figure 24, a sectional view in Figure 25, and a bottom view in Figure 26. Ex. 1004 ¶ 110. As shown in these figures, high power LED package 700 includes package body 702, recess 708, sealant 710, LED chip 712, and first and second sheet metal members 714 and 716. *Id.* ¶ 112. Package body 702 is integrally formed with injection molded resin to have recess 708 for receiving LED 712 and is filled with sealant 710. *Id.* ¶¶ 112, 113. First and second sheet metal members 714 and 716 are positioned in package body 702 and function as a terminal and radiating means while supporting the LED chip 712. *Id.* ¶ 112. Package body 702 includes upper and lower portions 702A and 702B that are connected with each other at both longitudinal edges to stably fix the first and second sheet metal members 714 and 716 therebetween. *Id.* ¶ 113. Lee discloses that LED package 700 can be mounted on a board having a metal plate, an insulating layer, and a conductive pattern printed on the insulating layer. *Id.* ¶ 111.

Lee provides the following description of first sheet metal member 714:

The first sheet metal member 714 consists of first and second sections 714A and 714B overlapped vertically and combined in a half T shape, the first and second sections 714A and 714B having a width smaller than the package body 702. The first and second sections 714A and 714B are attached to each other with conductive epoxy and the like having high thermal and electric conductivity, rendering the current and heat transfer therebetween conducted smoothly. The first section 714A supports at one end the LED chip 712 in the recess 708 while being electrically connected thereto, and extends at the other end over the sidewall of the package body 702. The second section 714B is exposed at its bottom surface from the bottom face of the lower portion 702B of the package body, and extends at one end (positioned at right side in the drawing) over the sidewall of the package body thus to form a protrusion together with the other end of the first section 714A. Meanwhile, the second section 714B is formed shorter than the first section 714A such that generally half portion thereof adjacent to the LED chip 712 on the first section 714A is completely surrounded and fixed by the package body 702.

Ex. 1004 ¶ 114. Lee provides a similar description of second sheet metal member 716. *Id.* ¶ 115.

Lee discloses that, as result of the above-described structure, “heat generated at LED chip 712 can be transferred smoothly through first and second sections 714A and 714B of the first sheet metal member 714 to the metal plate of the board.” Ex. 1004 ¶ 116. In addition, Lee discloses that “metal member 714 has the half T shape, so that a path of foreign substances, moisture and the like intruded from the lower portion 702B of the package body into the package body becomes longer to improve reliability of the LED package 700.” *Id.* ¶ 117.

*E. Petitioner's Obviousness Ground*

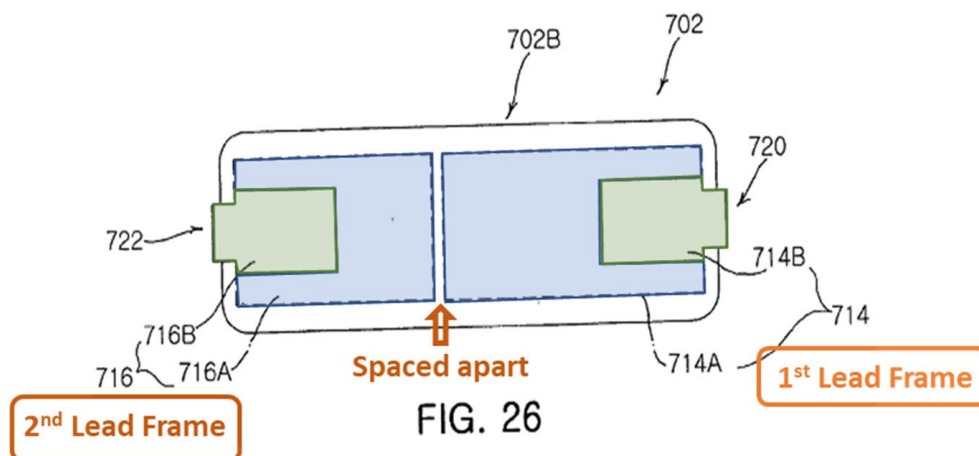
Petitioner contends that claims 1–16 are unpatentable as obvious over Lee. Pet. 58–72. Patent Owner opposes. PO Resp. 6–60. For the reasons discussed below, we determine that Petitioner has established by a preponderance of the evidence that claims 1–16 are unpatentable as obvious over Lee.

*1. Independent Claims 1 and 9*

*a) Undisputed Elements*

The parties' post-institution dispute centers on the “undercut sidewalls” limitation of independent claims 1 and 9. There is no dispute that Lee discloses the remaining limitations (hereinafter “the undisputed elements”) of claims 1 and 9. We find that Petitioner has shown that Lee discloses the undisputed elements of claims 1 and 9 for the reasons as set forth in the Petition and the Pattison Declaration. Pet. 22–27, 33–38, 52–54; Ex. 1003 ¶¶ 62, 64 (claim charts for claims 1 and 9); Ex. 1004 ¶¶ 56–58, 110–118, Figs. 24–26.

Our findings are illustrated by the following annotations of Lee Figures 25 and 26 reproduced from the Petition and the Pattison Declaration:



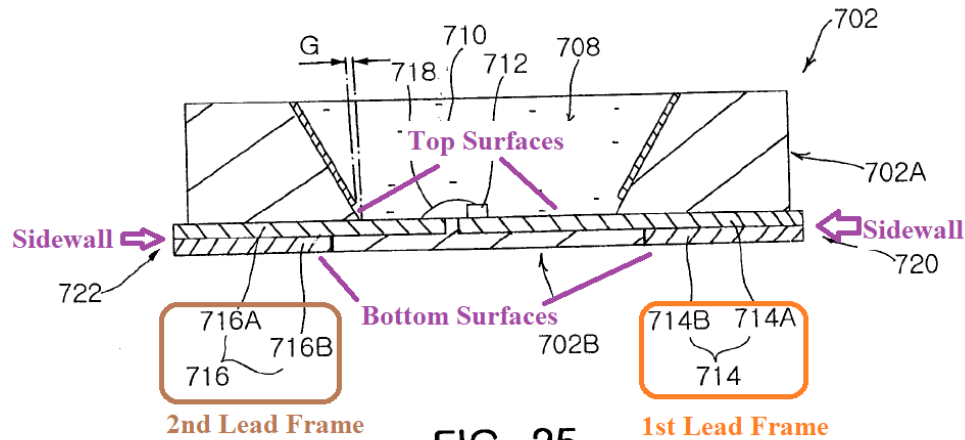


FIG. 25

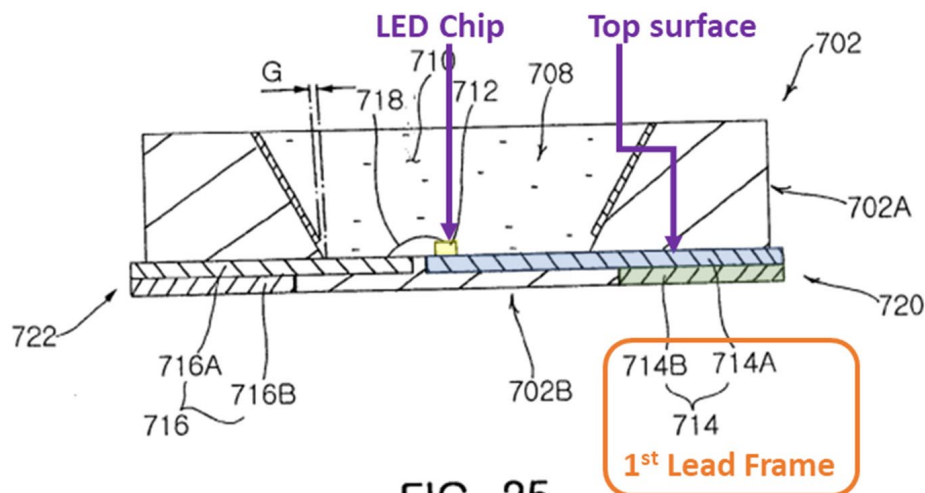
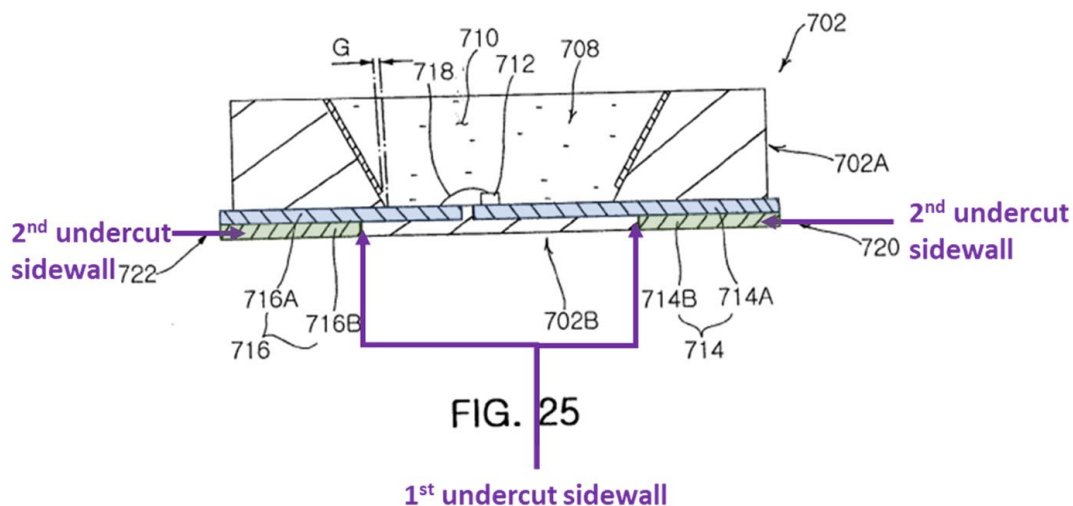
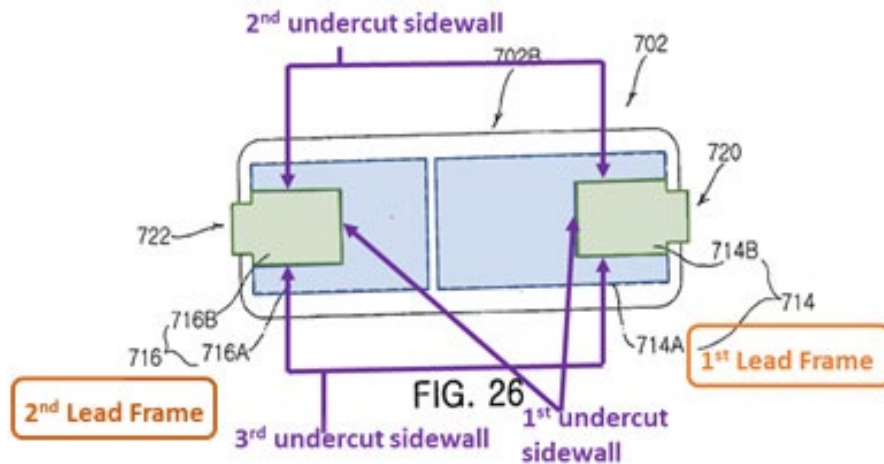


FIG. 25

Pet. 24–25, 27; Ex. 1003 ¶ 62. Lee Figures 25 and 26 depict a high power LED package. As illustrated by Petitioner’s annotations of Lee Figures 25 and 26, we find that Lee discloses first lead frame 714 and second lead frame 716 spaced apart from each other, the first and second lead frames each comprising a top surface, an opposing bottom surface and sidewalls arranged between the top surface and the bottom surface; and light-emitting diode chip 712 disposed on the top surface of first lead frame 714.

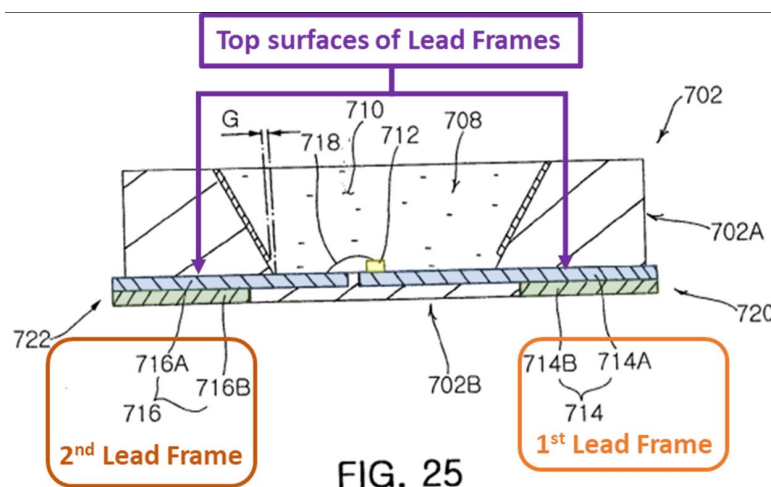
Our findings for the undisputed claim elements are illustrated by the following additional annotations of Lee Figures 25 and 26 reproduced from the Petition and the Pattison Declaration:



Pet. 28–29; Ex. 1003 ¶ 62. Lee Figures 25 and 26 depict a high power LED package. Petitioner’s annotations identify a first, second and third “undercut sidewall.” Our reproduction of Petitioner’s annotations should *not* be construed as a finding that the unmodified structures Petitioner identifies are “undercut sidewalls.” Instead, we use Petitioner’s annotations to illustrate our findings for the undisputed claim elements, including that each of first lead frame 714 and second lead frame 716 comprises a first sidewall, a second sidewall, and a third sidewall that at least partially define a fixing

space, the fixing space being formed by the sidewalls of first lead frame 714 and second lead frame 716. In addition, as illustrated by Petitioner's annotations, we find that first lead frame 714 and second lead frame 716 face each other in a horizontal direction such that the first sidewall of first lead frame 714 faces the first sidewall of second lead frame 716. The second sidewall and the third sidewall of first lead frame 714 are parallel to each other and perpendicular to the first sidewall of first lead frame 714, and the second sidewall and the third sidewall of second lead frame 716 are parallel to each other and perpendicular to the first sidewall of second lead frame 716.<sup>8</sup>

Our findings for the undisputed claim elements are illustrated by the following additional annotations of Lee Figure 25 reproduced from the Petition and the Pattison Declaration:



<sup>8</sup> We intentionally omit the word “undercut” from our findings for the undisputed elements of claims 1 and 9, and we do not find that the unmodified structures Petitioner identifies are in fact “undercut sidewalls.” As discussed below, we find that Petitioner has shown that its proposed **modification** of Lee’s Figures 24–26 embodiment has undercut sidewalls.

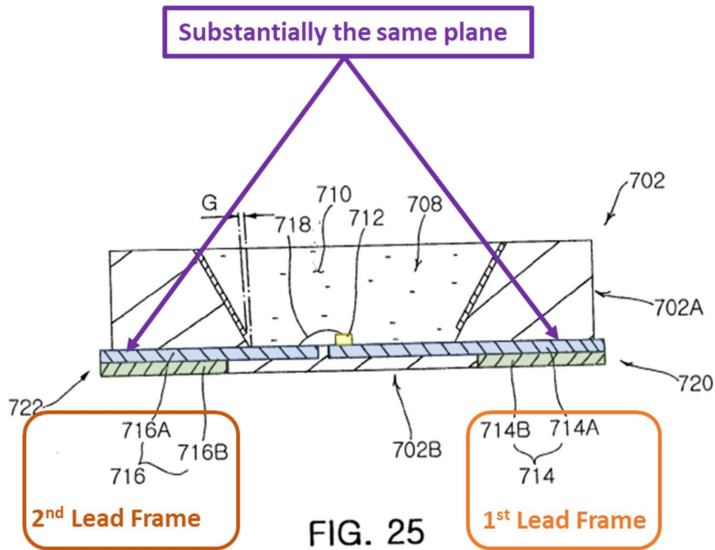


FIG. 25

Pet. 34, 54; Ex. 1003 ¶¶ 62, 64. Lee Figures 25 and 26 depict a high power LED package. As illustrated by Petitioner's annotations of Lee Figure 25, we find that Lee discloses that the top surfaces of first and second lead frames 714, 716 are substantially flat and are on substantially the same plane.

For the undisputed claim elements, Petitioner’s obviousness ground is based on the same arguments and evidence as it presents for its anticipation ground. Pet. 65–66, 68, 70–71. It is undisputed, and we find, that Petitioner’s showing for the undisputed elements is equally applicable to Petitioner’s obviousness grounds, which, as discussed below involves a modification of the embodiment shown in Lee Figures 24–26 wherein the lead frames are each made from a single metal sheet instead of two metal sheets attached to each other with epoxy (as Lee expressly discloses). *See* Pet. 63–65 (discussing motivation to modify the embodiment shown in Lee Figures 24–26).

*b) Undercut Sidewalls*

Petitioner contends that “even if the challenged claims require a metal processing step, such as etching, physical cutting, punching or the like,” the challenged claims are still unpatentable over Lee. Pet. 61–62. Petitioner contends that “a POSITA would have found it obvious to use single pieces of metal having ‘undercuts’ to create Lee[]’s first and second lead frames,” instead of “two pieces of metal adhered to one another,” as Lee discloses for the embodiment of Figures 24–26. Pet. 63–64. According to Petitioner, “[a] POSITA would have found it obvious to create these single metal pieces by physically cutting, punching, or etching them into the desired shape.” Pet. 64.

Patent Owner argues that Petitioner has not shown that its proposed modification of the embodiment shown in Lee Figures 24–26 has “undercut sidewalls,” as we have construed that term. PO Resp. 6–7, 27–33.

As discussed above, we construe “undercut sidewalls” as “sidewalls having a structure consistent with material having been cut away from the underside so as to leave an overhanging portion in relief.” After considering the parties’ arguments and evidence, we are persuaded that Petitioner has met its burden to show that its proposed modification of the embodiment shown in Lee Figures 24–26 would result in “undercut sidewalls” within the scope of our construction. Petitioner shows persuasively that Lee “discloses other embodiments where the first and second lead frames consist of a single component from which material is removed to form undercut sidewalls,” by cutting, punching, or etching a source sheet metal plate. Pet. 62–63 (citing Ex. 1004 ¶¶ 21, 29, 67–70, 97, 108, 109, 122, 127, 131, Fig. 4).

Our finding is supported by Lee’s teachings that lead frames can be made by selective etching to reduce the thickness of a source metal sheet.

Ex. 1004 ¶¶ 29, 70, 97, 122, 127, Figs. 4, 28, 29. For example, Petitioner relies on the following colored version of Lee Figure 4:

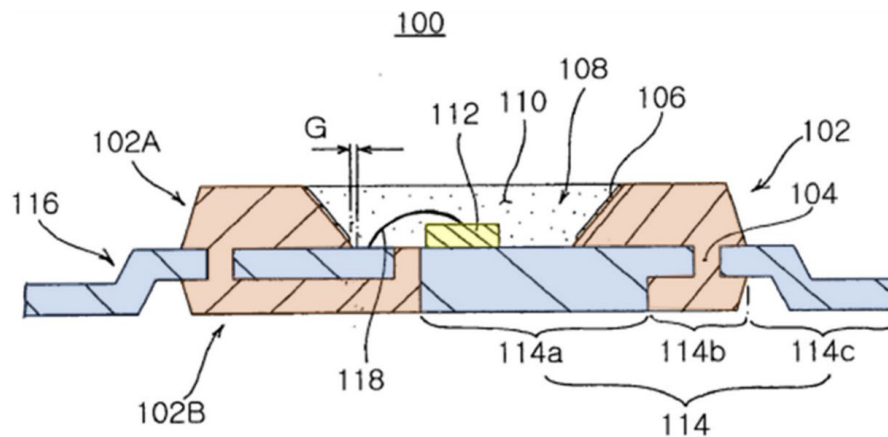
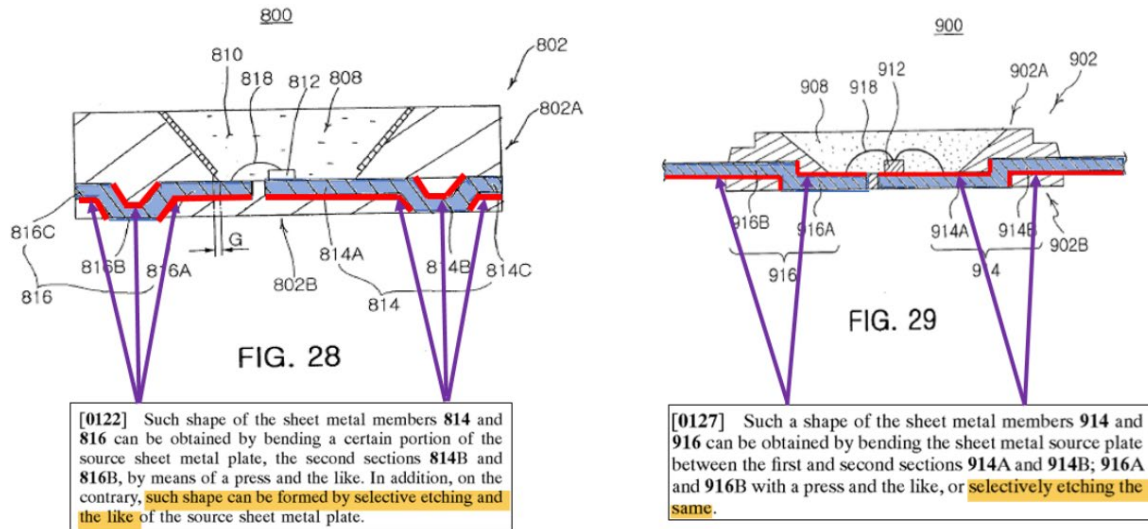


FIG. 4

Pet. 62. Lee Figure 4 shows an LED package having first and second sheet metal members 114 and 116, which function as lead frames. Ex. 1004 ¶¶ 67, 74; *see also* Ex. 1003 ¶¶ 52, 67 (discussing Lee Figure 4). Lee discloses that “[a] cross-sectional shape of these sheet metal members 114 and 116 may be formed by . . . cutting and punching a source sheet metal plate, and selectively reducing thickness through etching.” Ex. 1004 ¶ 70. According to Lee, second and third sections 114b and 114c extend integrally from first section 114a and have a reduced thickness relative to first section 114a. *Id.* ¶ 69. Patent Owner’s expert, Dr. Han, agreed that, when portion 114b is formed by etching, an undercut sidewall is formed in portion 114a in Lee Figure 4. Ex. 1022, 127:12–128:6. We find that Lee Figure 4, the description of that figure, and Dr. Han’s testimony provide persuasive support for Petitioner’s argument that Lee teaches selective etching as a way to reduce the thickness of a single piece of metal so as to remove material from the underside and form an undercut sidewall. Pet. 62–63; Ex. 1003 ¶¶ 55, 67.

As further support for its argument, Petitioner presents the following annotations of Lee Figures 28 and 29 and the corresponding paragraphs 122 and 127:



Pet. Reply 16; *see also* Pet. 63 (quoting Lee's descriptions of Figures 28 and 29 in paragraphs 122 and 127). Lee Figure 28 shows an LED package having first and second sheet metal members 814 and 816, and Lee Figure 29 shows an LED package having first and second sheet metal members 914 and 916. Ex. 1004 ¶¶ 120, 125. Lee discloses that the shape of the sheet metal members can be obtained either by bending a source sheet metal plate or by selective etching of the source sheet metal plate. *Id.* ¶¶ 122, 127. We find that Lee's Figures 28 and 29 and the description of those figures provide additional persuasive support for Petitioner's argument that Lee teaches forming a lead frame from a single piece of metal by selectively etching the underside to remove material and form an undercut sidewall. Pet. 63; Pet. Reply 15–16; Ex. 1003 ¶¶ 55, 67.

Lee's teachings about Figures 4, 28, and 29, as discussed above, provide persuasive evidence that, if the lead frames in Lee Figures 24–26 were made by selective etching, then their sidewalls would have a structure

consistent with material having been cut away from the underside so as to leave an overhanging portion in relief, as provided in our claim construction.

Patent Owner argues that “Petitioner and its expert provided no analysis or evidence regarding whether its purported modifications to FIGS. 24–26 are consistent with one that had material that had been cut away.” PO Resp. 29. We disagree. Petitioner and Dr. Pattison show that cutting material away by selective etching would have been one way to form the lead frames shown in Lee Figures 24–26 with undercut sidewalls. Pet. 62–65; Pet. Reply 15–16; Ex. 1003 ¶¶ 55, 67; Ex. 1024 ¶¶ 21–23. Patent Owner’s declarant, Dr. Han, agreed that if sheet metal member 714 in Lee Figures 24–26 were made by etching, then “it has a side wall, undercut side wall.” Ex. 1022, 110:18–111:5.

Patent Owner argues that Lee Figures 24–26 provide “a thin lead frame” having “large overhangs” and that cutting metal to make these lead frames would be “impractical” because “cutting is practical only for smaller features and at certain cutting angles.” PO Resp. 30 (citing Ex. 2023, 143:10–22, 172:8–14). From this, Patent Owner concludes that “a POSITA would not have viewed Petitioner’s modifications to Lee as ‘consistent’ with a frame that practically had material cut away from it.” *Id.* In our view, however, Patent Owner’s argument focuses on cutting and disregards Petitioner’s evidence about etching. Patent Owner’s evidence does not rebut Petitioner’s showing that sheet metal members 714 and 716 in Lee Figures 24–26 could be made by selective etching to form an undercut sidewall. As discussed above, Petitioner and Dr. Pattison show persuasively that Lee teaches making similarly shaped lead frames by etching to reduce the thickness of a source metal sheet so as to remove material from the underside and form an undercut sidewall. Pet. 62–65; Pet. Reply 15–16;

Ex. 1003 ¶¶ 55, 67; Ex. 1004 ¶¶ 29, 67–70, 122, 127, Figs. 4, 28, 29;  
Ex. 1024 ¶¶ 22, 23. Regarding Patent Owner’s impracticality argument, we credit Dr. Pattison’s deposition testimony concerning a “selective step etch” or “mesa etch.” Ex. 2024, 122:20–124:14, 125:12–127:19. In response to questions from Patent Owner’s counsel, Dr. Pattison persuasively testified that the frames 714 and 716 in Lee Figure 25 could be created by wet chemical etching or reactive ion etching using a photoresist to mask the area denoted by 714B that should not be etched. *Id.*

To the extent Patent Owner argues that “undercut sidewalls” have a size limitation that excludes large, thin overhangs (*see* PO Sur-reply 11–13), we disagree. We discern no such size limitation in the claims themselves. Nor does our claim construction include a size limitation. Rather, our claim construction may be viewed as recognizing a shape limitation, insofar as the structure must be consistent with material having been cut away from the underside so as to leave an overhanging portion in relief. We are persuaded that Petitioner has shown that if sheet metal members 714 and 716 were made from a single piece of metal by etching to reduce the thickness of the metal and form overhanging portions 714A and 716A, then they would have “undercut sidewalls” within the scope of our claim construction.

*c) Motivation*

As a motivation for modifying the embodiment shown in Lee Figures 24–26 by making the lead frames from single pieces of metal having “undercuts,” Petitioner contends that a “POSITA would have known that both electrical and thermal conductivity are likely improved when using a single, monolithic piece of metal because metal is generally more conductive (both thermally and electrically) than adhesives.” Pet. 64. In addition,

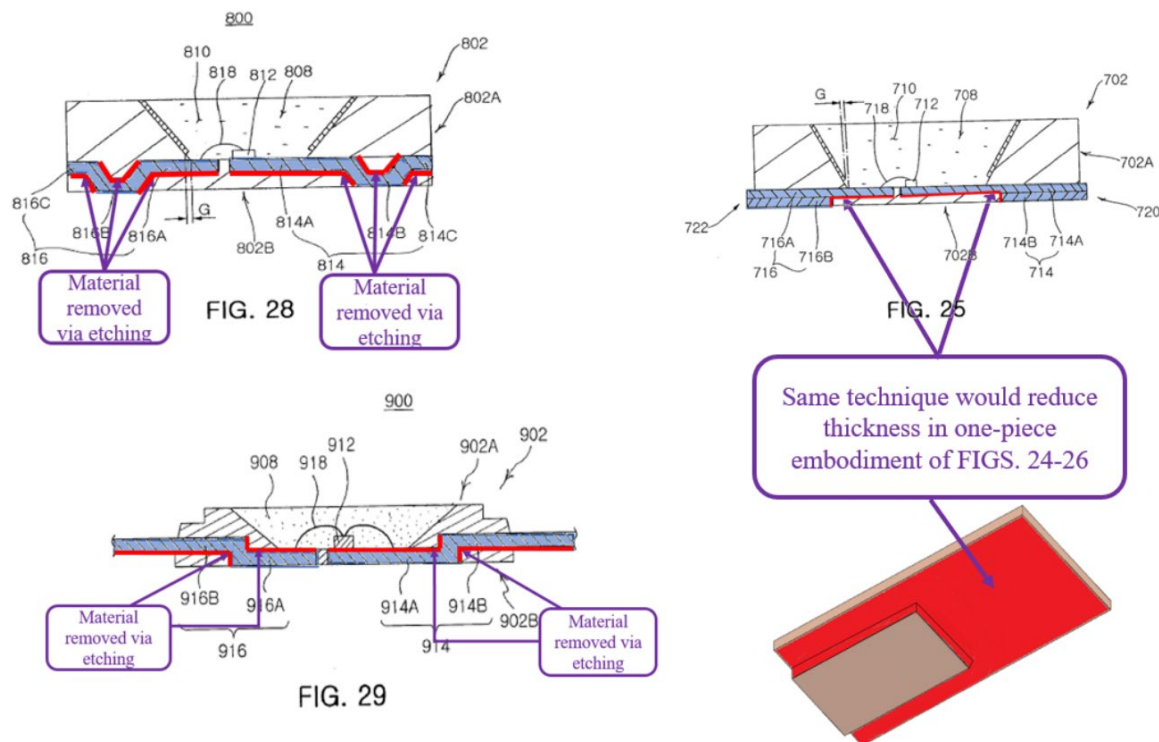
Petitioner contends that “[a] POSITA would have found it obvious to create these single metal pieces by physically cutting, punching, or etching them into the desired shape as Lee[] already discloses that its lead frames can be created in this manner.” *Id.* (citing Ex. 1004 ¶¶ 21, 32, 70, 108, 109, 131). Petitioner relies on Dr. Pattison’s testimony as support for its contentions. Ex. 1003 ¶¶ 67, 68.

Patent Owner argues that Petitioner’s proposed modification deviates from Lee’s teachings, that a POSITA would not have been motivated to modify the embodiment shown in Lee Figures 24–26, and that Petitioner’s arguments rely on impermissible hindsight bias. PO Resp. 7–27, 33–60.

After considering the parties’ arguments and evidence, we are persuaded that Petitioner has met its burden to show a motivation for its proposed modification of Lee Figures 24–26. We find that a POSITA would have been motivated to modify the embodiment shown in Lee Figures 24–26 by making the lead frames from a single metal sheet, rather than by attaching two metal sheets to each other with epoxy. Pet. 62–65; Pet. Reply 10–13; Ex. 1003 ¶¶ 66–68. We credit Dr. Pattison’s testimony that “[a] POSITA would have known that both electrical and thermal conductivity are likely improved when using a single, monolithic piece of metal because metal is generally more conductive (both thermally and electrically) than adhesives.” Ex. 1003 ¶ 68. We also credit Dr. Pattison’s testimony that a POSITA would have found it obvious to create lead frames from single metal pieces by selectively etching to reduce the thickness of a source metal sheet because Lee discloses that lead frames can be created in this manner. *Id.* Dr. Pattison’s testimony is supported by Lee’s teachings about the importance of electrical and thermal conductivity (Ex. 1004 ¶¶ 3, 13, 23, 114, 115), as well as Lee’s teachings about forming sheet metal

members from a source sheet metal plate by selective etching (*id.* ¶¶ 29, 70, 97, 122, 127).

As discussed above, Petitioner and Dr. Pattison show persuasively that Lee teaches selective etching to reduce the thickness of a source metal sheet as one way to make lead frames having a shape similar to the shape of the lead frames of Figures 24–26. Pet. 62–65; Pet. Reply 15–16; Ex. 1003 ¶¶ 55, 67; Ex. 1004 ¶¶ 29, 67–70, 122, 127, Figs. 4, 28, 29; Ex. 1024 ¶¶ 22, 23. Petitioner illustrates this concept with the following comparison of annotated versions of Lee Figures 28 and 29 with an annotation of Lee Figure 25 and a perspective view of the lead frame of the embodiment shown in Lee Figures 24–26:



Pet. Reply 16; Ex. 1024 ¶ 22. The above figures show LED packages and a perspective view of a lead frame. Petitioner’s annotations of Lee Figures 28 and 29 identify where material has been removed from a metal sheet by

selective etching to reduce the thickness of part of the metal sheet.

Petitioner's annotations of Figures 28 and 29 are supported by Lee's disclosure that the lead frames in these embodiments can be formed by selectively etching a source sheet metal plate. Ex. 1004 ¶¶ 122, 127.

Petitioner's comparison shows persuasively that selectively etching a single metal sheet would have been an obvious alternative to attaching two metal sheets to each other with epoxy as a way of forming the lead frames of the embodiment shown in Lee Figures 24–26. Pet. 62–65; Pet. Reply 15–16.

As demonstrated by Petitioner's comparison, the lead frames of Figures 24–26 are sufficiently similar in shape to the lead frames of Figures 28 and 29, such that the size of the area that would need to be etched and the thickness of both the source metal sheet and the resulting product would not be significantly different for the lead frames of Figures 24–26, as compared with the lead frames of Figures 28 and 29, which Lee expressly teaches can be made by selective etching to reduce the thickness of a source metal sheet. Ex. 1004 ¶¶ 122, 127.

We have considered Patent Owner's argument that Petitioner's proposed modification deviates from Lee's teachings. PO Resp. 7–27. In our view, however, the lead frames shown in Figures 24–26 are sufficiently similar in shape to the lead frames shown in Figures 4, 28, and 29 that a POSITA would have appreciated that Lee's teaching about using selective etching to reduce the thickness of a source metal sheet to form the lead frames in Figures 4, 28, and 29 would be applicable as an alternative way of making the lead frames in Figures 24–26. Ex. 1004 ¶¶ 70, 122, 127; *see also* Ex. 1003 ¶ 67 (Dr. Pattison's testimony summarizing Lee's teachings of various ways to make lead frames); Ex. 1024 ¶ 22 (Dr. Pattison: "Lee[]

expressly discloses using selective etching to form large features in various, relatively thin lead frames, as shown in at least FIGS. 4, 28, and 29.”).

Patent Owner argues that lead frames for LEDs are made in batches from large metal sheets containing an array of lead frames (PO Resp. 13–24), but does not argue that selective etching, as taught by Lee, is inapplicable to such batch manufacturing. In fact, Patent Owner’s declarant, Dr. Hansen, illustrates an exemplary array of lead frames she says could be made by “[p]erforming cutting, punching, and/or etching on a metal sheet to create Lee’s FIGS. 24–26.” Ex. 2009 ¶¶ 67–70. Furthermore, Patent Owner directs us to Dr. Pattison’s deposition testimony that etching “is a production practical way” of making the step structure in Lee’s Figures 24–26. Ex. 2023, 171:20–172:7; *see* PO Resp. 36 (relying on Dr. Pattison’s testimony to argue that other methods—cutting and punching—would not be practical). Still further, although Dr. Hansen’s declaration states that “when Lee does use etching to reduce thickness it does so only in instances where smaller features are etched” (Ex. 2009 ¶ 84), Dr. Hansen conceded at her deposition that she “was not really referring to figure 28” of Lee. Ex. 1023, 141:4–17.

Patent Owner argues that Petitioner’s proposed modifications “would require additional processing, and more metal” as compared with attaching two metal sheets to each other with epoxy. PO Resp. 25–26; Ex. 2009 ¶¶ 59–70. We find that Patent Owner’s argument is not persuasively supported by the cited testimony because Dr. Hansen does not directly compare the number of processing steps or the amount of metal required for the two methods. The examples provided in Dr. Hansen’s testimony appear to show that the epoxy method would require removing more metal from the bottom sheet than would need to be removed from a single metal sheet by an

etching method. *Compare* Ex. 2009 ¶ 62 (illustrating bottom sheet made by cutting or punching), *with id.* ¶ 70 (illustrating metal sheet from which metal is removed by etching).

We have considered Patent Owner’s argument that it would have been neither possible nor practical to create the lead frames in Lee Figures 24–26 by etching single metal sheets. PO Resp. 36–41 (citing Ex. 2009 ¶¶ 74–85; Exs. 2011–2015). Patent Owner’s evidence does not outweigh Petitioner’s evidence that it would have been obvious to form the lead frames in Lee Figures 24–26 by etching. *See, e.g.*, Ex. 1003 ¶¶ 67, 68; Ex. 1004 ¶¶ 29, 70, 97, 122, 127; Ex. 1024 ¶¶ 21–23. Although Dr. Hansen testifies that the lead frames in Lee Figures 24–26 could not be made by etching (Ex. 2009 ¶¶ 74–85), it appears that Dr. Hansen does not consider whether such lead frames could be made by anisotropic etching. Ex. 1023, 106:21–107:22 (explaining isotropic and anisotropic etching techniques); *id.* at 108:3–15, 116:2–11 (Dr. Hansen’s annotation of Lee Figure 25 shows “[t]he impact of an isotropic etch” and “an inability to etch the shape of the lead frames in [F]igure 25 using isotropic etching”); *id.* at 108:19–109:4, 117:8–17 (Dr. Hansen does not have experience with anisotropic etching of metals, such as copper, the most common metal used for lead frames). Dr. Hansen’s testimony is persuasively rebutted by Dr. Pattison, who relies on some of the same evidence as Dr. Hansen and testifies that “a POSITA would have no difficulty etching complex lead frame shapes, including lead frames having undercut/overhanging portions and holes having a variety of sizes and shapes based on what is appropriate for a given design/application.” Ex. 1024 ¶ 28 (citing Exs. 1020, 1021, 1028, 2014); *see also id.* ¶¶ 24–27 (quoting from these exhibits).

We have also considered Patent Owner’s argument that Lee Figures 24–26 are “meaningfully different” from Lee’s other embodiments. PO Resp. 54–55. We are persuaded that the differences Patent Owner identifies, including the size of the overhang and the location of the LED relative to the overhang, would not dissuade a POSITA from making the lead frame from a single metal sheet by selective etching rather than by attaching two metal sheets to each other with epoxy. We credit Dr. Pattison’s testimony that a POSITA would have found it obvious to make the lead frames of Figures 24–26 by etching to selectively reduce the thickness of a metal sheet. Ex. 1003 ¶¶ 68; Ex. 1024 ¶¶ 21–23. We find that Dr. Pattison’s testimony is consistent with Lee’s teachings to use selective etching to make similarly shaped lead frames. Ex. 1004 ¶¶ 29, 70, 122, 127.

Patent Owner argues that increased conductivity is not a sufficient rationale for modifying the embodiment shown in Lee Figures 24–26 because “using epoxy (or metal) makes little material difference in device operation.” PO Resp. 56 (citing Ex. 2009 ¶¶ 100–103). Patent Owner argues that there would have been “no real reason” to make Petitioner’s modification because “Lee’s epoxy already addresses Petitioner’s stated problem—the epoxy in Lee provides high thermal and electric conductivity.” *Id.* at 56–57. We agree that Patent Owner’s argument has some merit, but it is not sufficient to tip the scales in Patent Owner’s favor. In our view, Petitioner’s proposed modification is relatively minor. Essentially, Petitioner contends that a POSITA would have changed the way the lead frames are made, without changing their shape or the design or method of manufacture of the rest of the LED package. Even a small improvement in thermal or electrical conductivity provides a sufficient reason for a POSITA to consider changing the way the lead frames are

made, particularly for high power applications. Pet. Reply 13; Ex. 1023, 147:15–151:13; Ex. 1024 ¶ 18.

Furthermore, the record shows an additional reason why a POSITA would have considered making Petitioner’s proposed modification. Drs. Han and Pattison agree that a two-piece lead frame joined by epoxy would have been more likely to break than a single-piece metal lead frame when subjected to high-power operation and high-heat environments. Ex. 1024 ¶ 19; Ex. 2001 ¶¶ 64–68; *see* Pet. Reply 14 (“Patentee’s own expert provides a rationale for using a one-piece lead frame, in addition to those originally offered by Petitioner.”). Thus, a POSITA concerned about mechanical device failure would have had a reason to make the lead frames for the embodiment shown in Lee Figures 24–26 from a single piece of metal.

Accordingly, we are persuaded that Petitioner has shown that a POSITA would have been motivated to modify the embodiment shown in Lee Figures 24–26 by making the lead frames by selectively etching a single metal sheet instead of by attaching two metal sheets to each other with epoxy.

*d) Reasonable Expectation of Success*

Petitioner contends that “‘undercutting’ metal into desired shapes by any of etching, physical cutting, or punching and the like was conventional, required no more than ordinary skill, and a POSITA would have had a reasonable expectation of success in making the lead frames of FIGS. 24–26 as single metal pieces.” Pet. 64 (citing Ex. 1004 ¶¶ 40–46, 68); *see also* Pet. 67 (citing Ex. 1003 ¶¶ 40–49, 55, 61, 68, 69).

Patent Owner contends that “[t]he Petition does not demonstrate that a POSITA would have achieved the desired result, or have had a reasonable expectation of success, if they attempted to recreate the metal sheets of FIGS. 24–26 as a single metal piece.” PO Resp. 2; *see also id.* at 35, 42, 48, 49 (same).

After considering the parties’ arguments and evidence, we determine that Petitioner has met its burden to show a reasonable expectation of success for its proposed modification of the lead frames in Lee Figures 24–26. Our finding is supported by Lee, which teaches that similarly shaped lead frames can be made as single pieces of metal by etching to selectively reduce the thickness of a source metal sheet. Ex. 1004 ¶¶ 29, 70, 122, 127, Figs. 4, 28, 29.

Our finding is also supported by the undisputed fact that the ’967 Patent does not disclose how to make a lead frame with undercut sidewalls. Ex. 1001, 3:48–52, 4:58–63, 5:55–63 (describing exemplary embodiments of fixing space defined by undercut sidewalls); Ex. 1003 ¶ 46 (Dr. Pattison: “the ’967 patent fails to explain how to create undercut sidewalls”); Ex. 1022, 39:20–40:3 (Dr. Han: the ’967 Patent does not describe how to form undercut sidewalls); *id.* at 50:12–51:5 (cutting, etching, and punching techniques for material removal of lead frames are not disclosed in the ’967 Patent, but were known to a POSITA before 2008). We agree with Petitioner that the lack of disclosure in the ’967 Patent of how to make a lead frame with undercut sidewalls supports a conclusion that a POSITA would have been aware of conventional techniques for doing so and would have had a reasonable expectation of success in modifying the embodiment shown in Lee Figures 24–25 to include undercut sidewalls. Pet. Reply 17–19.

*e) Conclusion for claims 1 and 9*

For all of the foregoing reasons, we determine that Petitioner has shown by a preponderance of the evidence that claims 1 and 9 are unpatentable as obvious in view of Lee.

*2. Dependent Claims 2–8 and 10–16*

There is no dispute that Lee discloses the additional limitations of dependent claims 2–8 and 10–16.<sup>9</sup> We find that Petitioner has shown that Lee discloses the additional limitations of dependent claims 2–8 and 10–16 for the reasons as set forth in the Petition and the Pattison Declaration. Pet. 38–50, 54–58, 69–72; Ex. 1003 ¶¶ 62, 64 (claim charts for dependent claims 2–8 and 10–16); Ex. 1004 ¶¶ 56–58, 110–118, Figs. 24–26.

*F. Petitioner’s Anticipation Ground*

In view of our determination that Petitioner has established unpatentability of claims 1–16 based on obviousness, we do not reach Petitioner’s anticipation ground.

*G. Patent Owner’s Contingent Motion to Amend*

Pursuant to 35 U.S.C. § 316(d)(1) and 37 C.F.R. § 42.121(a), Patent Owner filed a contingent Motion to Amend the ’967 Patent and proposed substitute claims 17–22, which should replace claims 1, 2, 6, 9, 10, and 14, if the Board determines that any of those claims is unpatentable. PO MTA 1–2. Patent Owner also requested preliminary guidance in accordance with the Pilot Program. *Id.* at 2.

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<sup>9</sup> Dependent claims 10–16 introduce the same limitations as those introduced in dependent claims 2–8 respectively. See Pet. 54–58 (claim charts); Ex. 1003 ¶ 63 (claim chart).

We issued our non-binding Preliminary Guidance, advising the parties that, on the contingent motion to amend record, Patent Owner demonstrated a reasonable likelihood that it had satisfied the procedural requirements imposed by 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121(a) for its Motion to Amend. Prelim. Guidance 3–4. We further advised the parties that, on the contingent motion to amend record, Petitioner did not demonstrate a reasonable likelihood that proposed substitute claims 17–22 were unpatentable for lack of enablement or obviousness. *Id.* at 5–11.

As discussed above, we determine that Petitioner has established by a preponderance of the evidence that claims 1–16 are unpatentable as obvious over Lee. Therefore, we proceed to address Patent Owner’s contingent motion to amend and proposed substitute claims 17–22, which correspond to original claims 1, 2, 6, 9, 10, and 14, respectively. For the reasons discussed below, we determine that Petitioner has not proven that the proposed substitute claims are unpatentable, and for that reason, we grant Patent Owner’s contingent Motion to Amend.

### *1. Applicable Law*

In an *inter partes* review, amended claims are not added to a patent as of right, but rather must be proposed as a part of a motion to amend. 35 U.S.C. § 316(d) (2018). The Board must assess the patentability of proposed substitute claims “without placing the burden of persuasion on the patent owner.” *Aqua Prods., Inc. v. Matal*, 872 F.3d 1290, 1328 (Fed. Cir. 2017) (en banc); see *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 at 3–4 (PTAB Feb. 25, 2019) (precedential) (“*Lectrosonics*”). Subsequent to the issuance of *Aqua Products*, the Federal Circuit issued a decision in *Bosch Automotive Service Solutions, LLC v. Matal*, 878 F.3d

1027 (Fed. Cir. 2017) (“*Bosch*”), as well as a follow-up Order amending that decision on rehearing. *See Bosch Auto. Serv. Sols., LLC v. Iancu*, No. 2015-1928 (Fed. Cir. Mar. 15, 2018) (Order on Petition for Panel Rehearing).

In accordance with *Aqua Products*, *Bosch*, and *Lectrosonics*, a patent owner does not bear the burden of persuasion to demonstrate the patentability of the substitute claims presented in the motion to amend. Rather, ordinarily, “the petitioner bears the burden of proving that the proposed amended claims are unpatentable by a preponderance of the evidence.” *Bosch*, 878 F.3d at 1040 (as amended on rehearing); *see Lectrosonics*, Paper 15 at 3–4; 37 C.F.R. § 42.121(d)(2). In determining whether a petitioner has proven unpatentability of the substitute claims, the Board focuses on “arguments and theories raised by the petitioner in its petition or opposition to the motion to amend.” *Nike, Inc. v. Adidas AG*, 955 F.3d 45, 51 (Fed. Cir. 2020).

## 2. *Proposed Substitute Claims*

The Motion to Amend includes proposed substitute claims 17–22. Proposed substitute claim 17 is reproduced below with the added limitations underlined (as compared to claim 1):

17. A light-emitting device, comprising:

a first lead frame and a second lead frame spaced apart from each other, the first and second lead frames each comprising a top surface, an opposing bottom surface, a fixing hole, and sidewalls arranged between the top surface and the bottom surface; and

a light-emitting diode chip disposed on the top surface of the first or second lead frame, wherein:

each of the first lead frame and the second lead frame comprises a first undercut sidewall, a second undercut sidewall, and a third undercut sidewall that at

least partially define a fixing space and interior portions of the first and second lead frames, the fixing space being formed by the undercut sidewalls of the first lead frame and the second lead frame,

each fixing hole is located in the interior portions of each of the first and second lead frames and includes an undercut sidewall that envelopes inner bounds of the fixing hole,

the top surfaces of the first and second lead frames are substantially flat, and

the first lead frame and the second lead frame face each other in a horizontal direction such that the first undercut sidewall of the first lead frame faces the first undercut sidewall of the second lead frame,

the second undercut sidewall and the third undercut sidewall of the first lead frame are parallel to each other and perpendicular to the first undercut sidewall of the first lead frame, and

the second undercut sidewall and the third undercut sidewall of the second lead frame are parallel to each other and perpendicular to the first undercut sidewall of the second lead frame.

PO MTA, App. A, 3–4.<sup>10</sup> Proposed substitute claim 20 includes the same underlined limitations as proposed substitute claim 17. *Id.* at 5–6. Proposed substitute claims 18 and 21 include a substantive amendment reciting that “a resin part comprising a phosphor [is] disposed in the fixing space to support the first and second lead frames.” *Id.* at 4–7. Proposed substitute claims 19 and 22 include a substantive amendment reciting that “a second fixing hole [is] formed in at least one of the interior portions of the first and second lead frames. *Id.*

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<sup>10</sup> Appendix A to Patent Owner’s Motion to Amend begins at page 3.

Patent Owner’s Motion to Amend states: “All dependent claims in the ’967 Patent (and dependent substitute Claims 18–19 and 21–22) ***all depend on substitute Claims 17 and 20***, and are patentable for the same reasons.” PO MTA 19 (emphasis added). As presented in Appendix A, however, proposed substitute claims 18 and 19 depend from original claim 1 (instead of proposed substitute claim 17), and proposed substitute claims 21 and 22 depend from original claim 9 (instead of proposed substitute claim 20). *Id.* App. A. Despite this apparent drafting error in Patent Owner’s claim listing in Appendix A, we determine patentability of proposed substitute claims 18, 19, 21, and 22 consistent with Patent Owner’s statement that they “all depend on substitute claims 17 and 20.” *Id.* at 19. Furthermore, Patent Owner’s claim listing in Appendix A does not include substitutes for dependent claims 3–5, 7, 8, 11–13, 15, and 16 to change their dependency. This omission appears to be unintentional in view of Patent Owner’s statement that “[a]ll dependent claims in the ’967 Patent . . . depend on substitute Claims 17 and 20.” *Id.*

### 3. *Procedural Requirements*

“Before considering the patentability of any substitute claims, . . . the Board first must determine whether the motion to amend meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121.” *See Lectrosonics*, Paper 15 at 4.

First, we consider whether the motion to amend proposes a reasonable number of substitute claims. 35 U.S.C. § 316(d)(1)(B). “There is a rebuttable presumption that a reasonable number of substitute claims per challenged claim is one (1) substitute claim.” *Lectrosonics*, Paper 15 at 4–5 (citing 37 C.F.R. § 42.121(a)(3)).

Patent Owner proposes substitute claims 17–22 as replacements for original claims 1, 2, 6, 9, 10, and 14. PO MTA 1–2, App. A.

Because Patent Owner’s Motion proposes no more than one substitute claim for each challenged claim, we determine that Patent Owner has proposed a reasonable number of substitute claims. *See* Prelim. Guidance 3 (taking same approach in preliminary guidance in finding that Patent Owner proposes a reasonable number of substitute claims).

Second, we consider whether the proposed substitute claims respond to a ground of unpatentability involved in this trial. *Lectrosonics*, Paper 15 at 5–6. Patent Owner argues that the proposed substitute claims respond to each of the trial grounds set forth in the Institution Decision. PO MTA 2–3. Patent Owner’s Motion to Amend also includes arguments and evidence addressing the grounds of unpatentability. *Id.* at 10–23. Petitioner does not argue that Patent Owner’s Motion to Amend fails to respond to a ground of unpatentability. We agree with Patent Owner that the proposed substitute claims respond to a ground of unpatentability involved in this trial.

Third, we consider the breadth of the proposed substitute claims. “A motion to amend may not present substitute claims that enlarge the scope of the claims of the challenged patent or introduce new subject matter.”

*Lectrosonics*, Paper 15 at 6–8 (citing 35 U.S.C. § 316(d)(3); 37 C.F.R. § 41.121(a)(2)(ii)). As to the requirement that the amendments may not enlarge the scope of the original claims, Patent Owner argues that its proposed substitute claims 17–22 add limitations and do not delete any limitations. PO MTA 3. Petitioner does not argue that Patent Owner’s amendment enlarges the scope of the claims. We determine that proposed substitute claims 17–22 are narrower in scope than claims 1, 2, 6, 9, 10, and

14 and that Patent Owner’s amendment does not enlarge the scope of the claims.

As to the requirement that the amendments not introduce “new matter,” Patent Owner provides citations to the application from which the ’967 Patent issued to demonstrate written description support for each limitation in the proposed substitute claims. PO MTA 3–10. Petitioner does not argue that Patent Owner’s Motion fails to meet the “no new matter” requirement. We agree with Patent Owner that the original disclosure supports the proposed amendment and that the proposed substitute claims do not introduce new matter.

Finally, the Contingent Motion includes a claim listing, as required by 37 C.F.R. § 42.121(b). PO MTA, App. A; *see Lectrosonics*, Paper 15 at 8. As discussed above, the claim listing appears to have inadvertent errors and omissions related to claim dependency.

In view of the above, we determine that Patent Owner’s contingent Motion to Amend meets the statutory and regulatory requirements of 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121 respectively.

#### *4. Claim Construction*

Patent Owner states that, in its Motion to Amend, it has applied the Board’s constructions for “lead frame” and “undercut sidewalls,” as set forth in the Institution Decision. PO MTA 24. Petitioner’s opposition does not address claim construction.

For the reasons discussed above, we construe the term “lead frame” as the “metal portion of a device package that makes electrical connections between a die and other parts of the circuitry.” We construe “undercut sidewalls” as “sidewalls having a structure consistent with material having

been cut away from the underside so as to leave an overhanging portion in relief.” These are the same constructions as we applied in the Institution Decision. Inst. Dec. 12, 16.

5. *Challenge to Patentability Based on Lack of Enablement*

Petitioner contends that proposed substitute claims 17–22 require undercut sidewalls and a fixing hole, and although Figure 6A of the ’967 illustrates the “newly claimed fixing holes,” it is “undisputed that the ’967 patent does not disclose how to create such undercut sidewalls or fixing holes.” Pet. MTA Opp. 1 (citing PO MTA 4–5; Ex. 1023, 27:24–28:10). Petitioner interprets the Patent Owner Response as arguing that a POSITA would not reasonably have been able to create undercut sidewalls in a one-piece version of Lee’s lead frames by etching, cutting, or punching. *Id.* at 1–2 (citing PO Resp. 2, 7–8, 34–35, 42, 48–49). Petitioner contends that “[i]f the PTAB accepts [Patent Owner’s] contentions regarding Lee, then the substitute claims are not enabled.” *Id.* at 2. Petitioner provides an analysis of the *Wands* factors, and contends that its analysis shows that “a POSITA would not [have been] able to make the claimed inventions of the substitute claims without undue experimentation.” *Id.* at 2–4 (citing *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988)). Petitioner’s *Wands* analysis relies on Patent Owner’s contentions about Lee. *Id.* In the Reply, Petitioner reiterates that “[i]f Patentee is correct, that a POSITA would require undue experimentation to form undercut sidewalls or fixing holes in the structure of Lee, then a POSITA would equally require undue experimentation to form undercut sidewalls or fixing holes in the structure of the ’967 patent.” Pet. MTA Reply 12.

After considering Petitioner’s Opposition and Reply, we determine that Petitioner presents no argument for non-enablement that is not contingent on the Board agreeing with Patent Owner’s argument that the challenged claims would not have been obvious in view of Lee. The contingent nature of Petitioner’s non-enablement argument is emphasized in the following passage from the Opposition:

To be clear, and as shown in Petitioner’s Reply, Petitioner’s position is that it is conventional to etch, cut, and punch lead frames to achieve any suitable lead frame structure, including undercut sidewalls and fixing holes. It is Patentee who believes the opposite. Patentee cannot have it both ways. Either it is conventional to etch, cut, and punch lead frames as shown in its ’967 patent, or there is no reasonable expectation of doing so successfully, i.e., undue experimentation is required.

Pet. MTA Opp. 3 n.1.

For the reasons discussed above, we do not accept Patent Owner’s non-obviousness argument, and we find that a POSITA would have had a reasonable expectation of success in modifying Lee’s Figures 24–25 embodiment to include undercut sidewalls made by etching. Because Petitioner’s non-enablement argument is contingent on an argument by Patent Owner that we reject, we reject Petitioner’s contingent non-enablement argument for the same reasons.

#### *6. Challenges to Patentability Based on Obviousness*

Petitioner asserts the following grounds of unpatentability against the proposed substitute Claims:

| <b>Proposed Substitute Claims Challenged</b> | <b>35 U.S.C. §</b> | <b>References</b>        |
|----------------------------------------------|--------------------|--------------------------|
| 17, 19, 20, 22                               | 103(a)             | Lee, Mahle <sup>11</sup> |

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<sup>11</sup> Ex. 1028, US 2004/0063244, published April 1, 2004 (“Mahle”).

| Proposed Substitute Claims Challenged | 35 U.S.C. § | References                        |
|---------------------------------------|-------------|-----------------------------------|
| 18, 21                                | 103(a)      | Lee, Mahle, Brunner <sup>12</sup> |

*7. Petitioner’s Challenge Based on Lee and Mahle*

*a) Overview of Mahle*

Mahle discloses an integrated circuit (“IC”) package having a lead frame-to-plastic mold lock. Ex. 1028, codes (54), (57), ¶¶ 1, 5, 21.

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<sup>12</sup> Ex. 1030, US 2004/0188697, published Sept. 30, 2004 (“Brunner”).

Figure 1 of Mahle is reproduced below.

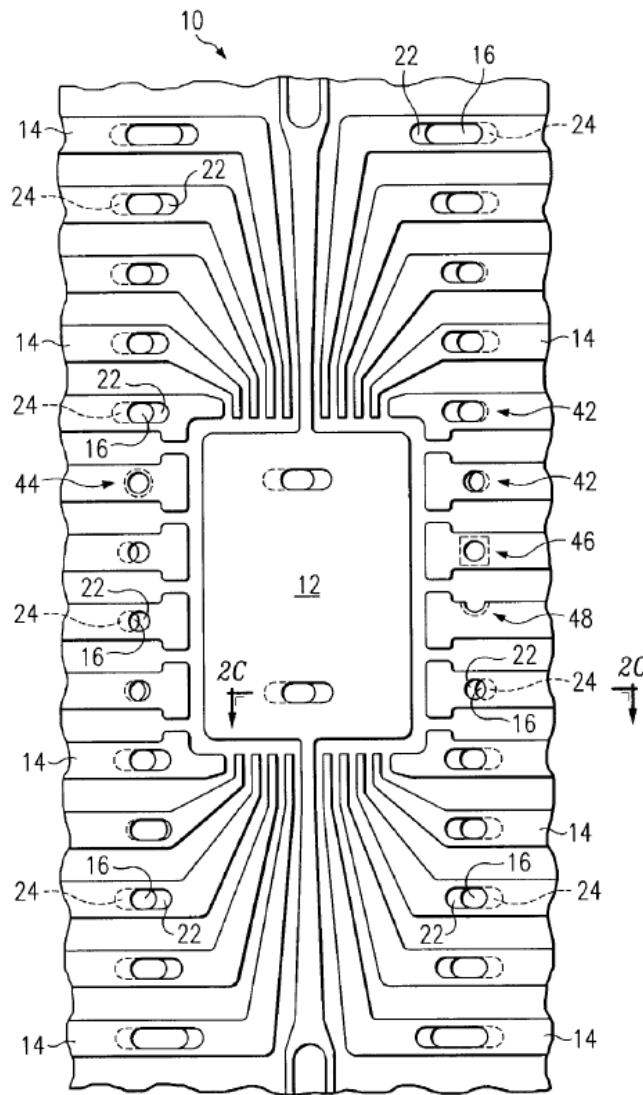
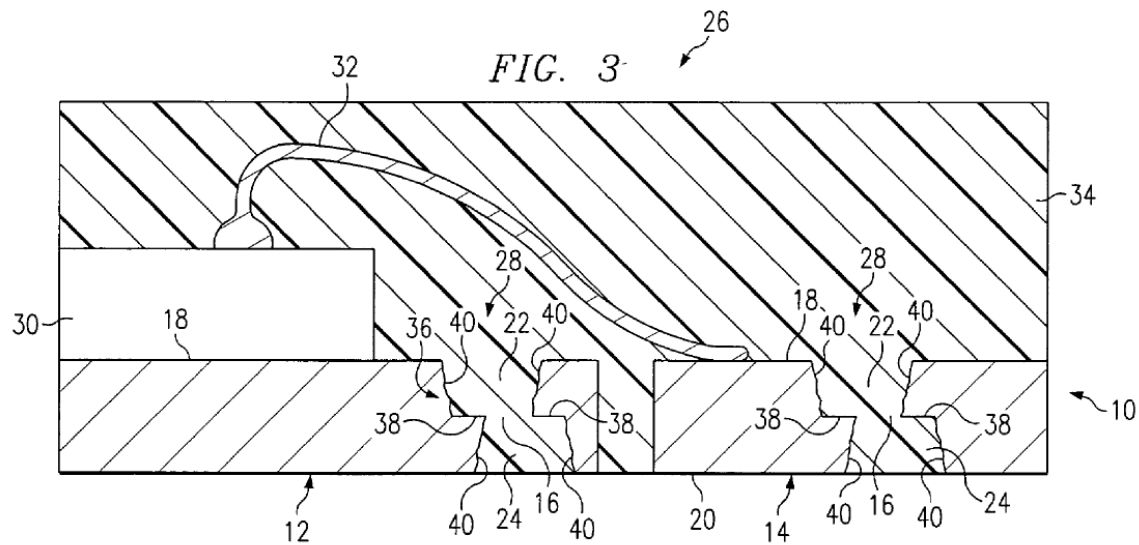


FIG. 1

Mahle Figure 1 shows an IC lead frame having mold locks. Ex. 1028 ¶ 12. As shown in Figure 1, lead frame 10 has die pad 12 and numerous lead fingers 14. *Id.* ¶ 21. Die pad 12 and each of lead fingers 14 have perforating apertures 16. *Id.*

Figure 3 of Mahle is reproduced below.



Mahle Figure 3 shows IC package 26 having lead frame locks 28. Ex. 1028 ¶ 24. As shown in Figure 3, lead frame 10 includes apertures 16 formed by partially etching opposed, axially offset niches 22, 24 in lead frame surfaces 18, 20 from either side. *Id.* ¶¶ 22–24; *see also* Figs. 2A–C (illustrating various stages in a method of making an IC package mold lock). Mahle discloses, as shown at 44 in Figure 1, that a relatively larger cylindrical niche may be axially aligned with an opposing relatively smaller cylindrical niche. *Id.* ¶ 27, Fig. 1.

*b) Analysis*

***Proposed substitute independent claims 17 and 20.*** These claims recite “a fixing hole,” wherein “each fixing hole is located in the interior portions of each of the first and second lead frames and includes an undercut sidewall that envelopes inner bounds of the fixing hole.” PO MTA, App. A, 3–6.

Petitioner contends that “Mahle discloses the exact same fixing holes.” Pet. MTA Opp. 13 (citing Ex. 1028 ¶ 27). More specifically,

Petitioner contends that Mahle's disclosure of a relatively larger cylindrical niche axially aligned with an opposing relatively smaller cylindrical niche results in "one cylindrical aperture sitting concentrically on top of another cylindrical aperture of larger diameter," which is what is claimed in substitute independent claims 17 and 20. *Id.* (citing Ex. 1028 ¶¶ 27; Ex. 1025 ¶¶ 37, 46, 64, 60–61). Petitioner further contends "a POSITA would [have been] motivated to use Mahle's lead frame locks, such as Mahle's version 44 lead frame locks, with Lee because (a) Lee would want additional locks in the interior of the lead frames to ensure that the package body is secured to the lead frame, and (b) Mahle's locks were a known way of locking an encapsulant to a lead frame." *Id.* at 13–14 (citing Ex. 1025 ¶¶ 73–83); *see also id.* at 10 ("A POSITA would be motivated to include additional fixing holes in these locations because a large volume of molding material may be at these locations, which large volumes need to be properly secured to the lead frame to ensure mechanical integrity and prevent moisture penetration.").

In our Preliminary Guidance, we made a preliminary finding that Petitioner does not sufficiently articulate a rationale as to why, absent impermissible hindsight, a POSITA would have modified the structure disclosed in Lee so as to form fixing holes within the interior portions of first and second sheet metal members 714 and 716. Prelim. Guidance 7–9.

In its Reply to the Preliminary Guidance, Petitioner reiterates its position that a POSITA would have been motivated to include fixing holes in the interior portions of the lead frame to secure the package body to the lead frame for mechanical integrity and to prevent moisture intrusion. Pet. MTA Reply 1–5.

Patent Owner responds that “Petitioner’s proposed modification of placing a hole in Lee’s T-Shaped cross section: (1) is inconsistent with Lee’s disclosure which places holes to connect a lower/upper portion of the package body; and (2) frustrates the purpose of Lee, which is to use the T-Shaped cross section for heat transfer and dissipation.” PO MTA Sur-reply 2–3.

After considering the parties’ arguments and evidence, we determine that Petitioner has not met its burden to show that a POSITA would have been motivated to combine the teachings of Lee and Mahle in the manner proposed. More specifically, we are not persuaded by Petitioner’s argument that preventing “securement issues and moisture penetration” would have motivated a POSITA to include fixing holes in the interior portions of the lead frame. Pet. MTA Opp. 10; Pet. MTA Reply 2.

Petitioner’s theory is that a POSITA would have been motivated to include ***additional*** apertures in Lee’s lead frame in addition to the aperture disclosed in Lee paragraph 113 and that an “obvious location” for such additional apertures is the interior portions of Lee’s lead frames. Pet. MTA Opp. 9–10; Pet. MTA Reply 2. Although one of the motivations advanced by Petitioner is ensuring that the package body is secured to the lead frame, Petitioner does not persuade us that a POSITA would have seen a need or benefit of adding fixing holes, when Lee already discloses several other features that stably secure the package body to the lead frame.

First, Lee discloses that “package body 702 is formed by injection molding of resin” and that “upper and lower portions 702A and 702B of the package body are connected with each other at their both [*sic*] longitudinal edges to stably fix the first and second sheet metal members 714 and 716 therebetween.” Ex. 1004 ¶ 113. Lee also discloses that lead frames 714 and

716 each have a width “smaller than the package body 702.” *Id.* ¶¶ 114, 115. These features are illustrated in Figure 26, which shows the perimeter of package body 702 extending beyond perimeter of lead frames 714, 716 along the longitudinal edges and along the sides, except for protrusions 720, 722 that extend through the sidewall of the package body. *Id.* Thus, Lee teaches that lead frames 714, 716 are sandwiched between upper and lower portions 702A and 702B of the package body, which are connected with each other along most of the perimeter of the package body.

Second, Lee discloses that “by forming a hole to each of the first sections 714A and 716A and connecting the upper and lower portions 702A and 702B of the package body together through the holes, it is possible to fix the first and second sheet metal members 714 and 716 more stably.”

Ex. 1004 ¶ 113. Petitioner asserts that these holes are the “fixing holes” recited in original dependent claims 6 and 14. Pet. 45, 56–57. Although Lee states that these holes are not illustrated in Figures 24–26 (Ex. 1004 ¶ 113), Petitioner provides the following modified version of Lee Figure 25 to show the fixing holes disclosed by Lee:

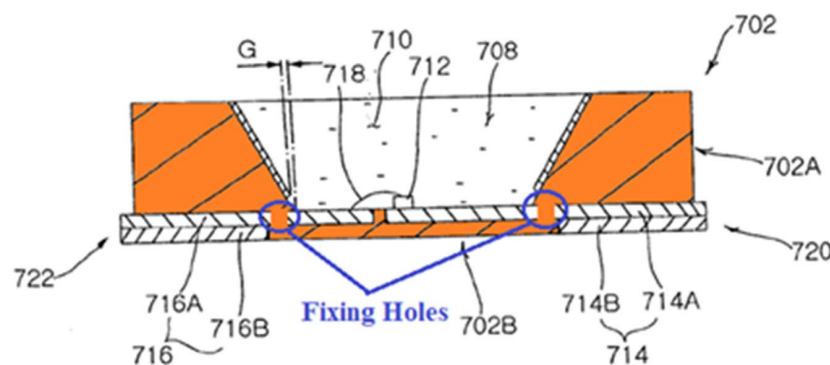


FIG. 25

Lee Figure 25 shows an LED package. Petitioner’s modification shows a hole extending vertically through each of lead frame sections 714A and

716A, and each hole is filled with resin to form a post that connects upper and lower portions 702A and 702B of the package body, shown in orange. Pet. 48; Ex. 1004 ¶¶ 17, 67, 106, 113. Petitioner contends that these connecting posts secure the lead frame to the package body. Pet. MTA Reply 2–3.

Third, Lee discloses that sections 714A and 716A form a “generally half portion” of the lead frame and are “completely surrounded and fixed by the package body 702.” Ex. 1004 ¶¶ 113–115, Fig. 26 (bottom view of LED package showing lead frame sections 714A and 716A with dotted lines to indicate they are embedded within package body 702). Petitioner shows that the resin that surrounds lead frame sections 714A and 716A is “located in a fixing space,” thus ensuring that the package body is secured to the lead frame. Pet. 40–41. Petitioner illustrates this securement with the following annotation of Lee Figure 25:

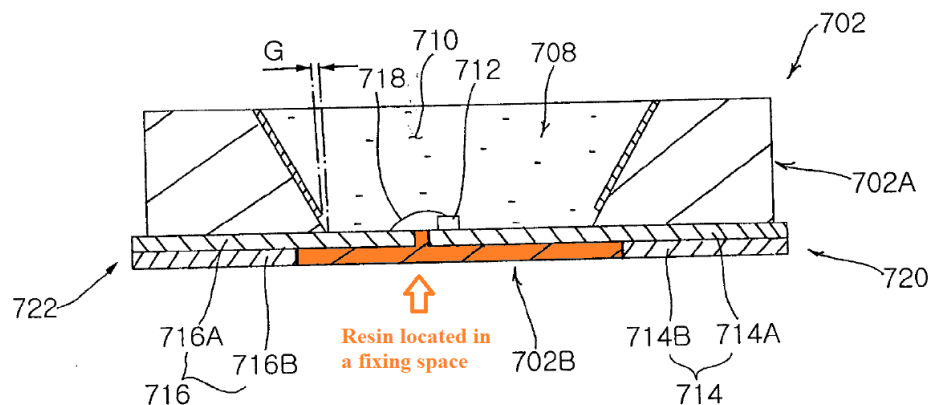


FIG. 25

Pet. 41. Lee Figure 25 shows an LED package, and Petitioner’s annotation identifies “resin located in a fixing space” beneath lead frame sections 714A and 716A. *Id.* As shown by Lee Figure 26 and Petitioner, this fixing space surrounds lead frame sections 714B and 716B on three sides. Pet. 29 (annotation of Lee Fig. 26 identifying three undercut sidewalls that “define a

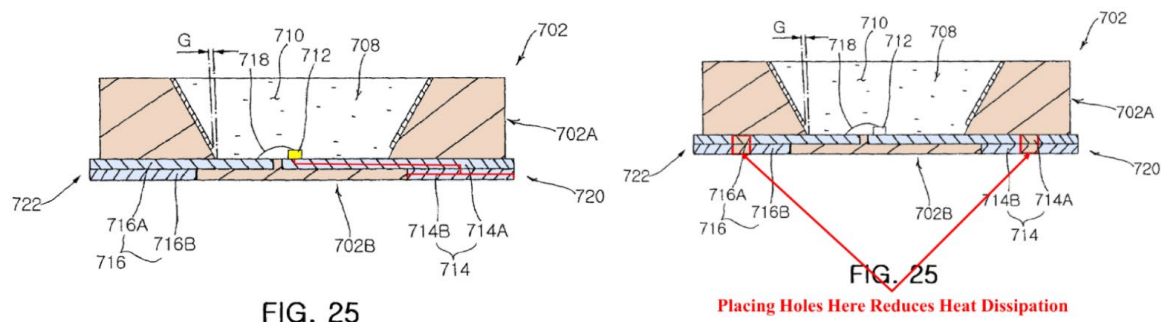
fixing space that is filled with resin to form the package body”). Thus, Lee teaches, and Petitioner’s contentions confirm, that package body 702 is securely attached to lead frames 714 and 716 because sections 714A and 716A are “completely surrounded and fixed by the package body 702” (Ex. 1004 ¶ 114) and because the resin that forms the package body fills a “fixing space” beneath these lead frame sections. Pet. 41.

In sum, Lee teaches at least three ways that the lead frames are stably fixed to the package body in the Figures 24–26 embodiment:

(1) connections between the upper and lower portions of the package body along its perimeter; (2) posts connecting the upper and lower portions of the package body together through the holes in the lead frames; and (3) lead frame sections that are completely surrounded and fixed by the package body. Ex. 1004 ¶¶ 67, 113–115. In view of these teachings, we are not persuaded that a POSITA would have perceived a need for or benefit to adding fixing holes to more securely attach the lead frames to the package body, as argued by Petitioner.

Our finding is reinforced by Lee’s teachings about heat transfer. Lee teaches that an important function of the sheet metal lead frame is to transfer heat from the LED chip to the metal plate of the underlying board. Ex. 1004 ¶ 13 (stating that an object is to provide a high power LED package in which a sheet metal member serves as a radiating means for conducting heat generated by an LED chip to a metal plate of a board, thereby raising thermal radiation efficiency while reducing the size and thickness of the package). With respect to the embodiment shown in Figures 24–26, Lee teaches that “heat generated at the LED chip 712 can be transferred smoothly through the first and second sections 714A and 714B of the first sheet metal member 714 to the metal plate of the board.” *Id.* ¶ 116.

Even though Patent Owner does not have the burden of proof to show patentability of its proposed substitute claims, Patent Owner shows persuasively that Petitioner's modification of Lee's Figures 24–26 embodiment would frustrate Lee's purpose of using the lead frame to transfer heat from the LED chip. PO MTA Sur-reply 4–7. Patent Owner shows that it is well known that heat transfer is proportional to the contact surface area between the board and the metal. *Id.* at 6, 8 (citing Ex. 1019, 13<sup>13</sup>). The cited exhibit teaches that “[k]ey heat sink performance parameters include (1) a large surface area to spread the heat generated by the LED and provide access to circulating air; [and] (2) a flat contact area to provide effective heat transfer from the PCB.” Ex. 1019, 13. Patent Owner presents the following annotations of Lee Figure 25 to illustrate the heat transfer path from the LED chip to the board and the reduction of heat dissipation that would result from Petitioner's proposed modification.



PO MTA Sur-reply 6. Lee Figure 25 shows an LED package. Patent Owner's annotations show persuasively that, if holes were placed in the interior portions of the lead frames, then the contact surface area between the

<sup>13</sup> K. Bahde, *Thermal Management for LED Luminaires*, LED Professional Review (Nov./Dec. 2007). Like Patent Owner, we cite to Exhibit 1019 using the page numbers added by Petitioner.

lead frame (i.e., the head dissipator) and the underlying board would be reduced, reducing the LED package's ability to dissipate heat. *Id.* at 6–7.

In the Preliminary Guidance, we stated that “Petitioner also does not address how its proposed modification would affect Lee’s design considerations pertaining to heat transfer and moisture intrusion.” Prelim. Guidance 9 (citing Ex. 1004 ¶¶ 116, 117; Inst. Dec. 18). In the reply, Petitioner addresses heat transfer by asserting: “There is also no evidence that adding a fixing hole at Lee’s interior would create any issues with heat transfer. To the contrary, Lee discloses using multiple fixing holes []and discloses that a plurality of fixing holes is desirable to secure the package body to the lead frame.” Pet. MTA Reply 4–5 (citing Ex. 1025 ¶ 32; Ex. 1004, ¶¶ 17, 117, Figs. 5, 14). Petitioner’s argument is not persuasive because the “multiple fixing holes” Petitioner identifies in Lee are posts that connect the upper and lower portions of the package body and, unlike Petitioner’s added fixing holes, they do not reduce the surface area of the lead frame that is in contact with the underlying board. *See* Ex. 1004, ¶ 67, Figs. 4, 5, 8, 9, 11, 13–19 (showing posts 104, 204, 304, 404, 504, or 604 connecting upper and lower portions of package body); *see also id.* ¶ 80 (stating that “constitutional elements the same as or similar to those of the LED package 100 are designated with corresponding reference numerals, increased by 100”).

Petitioner argues that a POSITA would have been motivated to include additional fixing holes in the interior portions of Lee’s lead frames to prevent moisture intrusion. Pet. MTA Opp. 10; Pet. MTA Reply 2, 5 (citing Ex. 1025 ¶¶ 50, 51, 56, 59, 63, 73, 79, 80, 94). Neither Petitioner nor Dr. Krames explains sufficiently, however, how adding fixing holes in the interior portions of the lead frames in the embodiment shown in Lee Figures

24–26 would prevent moisture intrusion. We are persuaded by Patent Owner’s argument that placing fixing holes in the interior portions would create “yet another extra resin/metal junction where moisture can penetrate and propagate inside the LED chip.” PO MTA Sur-reply 7. Patent Owner’s argument is supported by the above annotation of Lee Figure 25, which shows that Petitioner’s proposed hole placement would allow another point where moisture could infiltrate the LED package from the outside. Patent Owner’s argument is also supported by Dr. Hansen’s annotation of Lee Figure 25 identifying a first path for moisture intrusion.

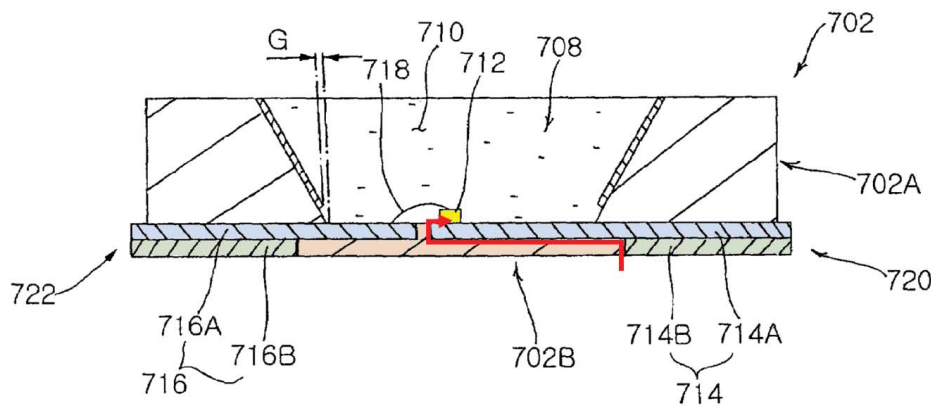


FIG. 25

Ex. 2009 ¶ 47. Lee Figure 25 shows an LED package, and the red arrow added by Dr. Hansen identifies a moisture path from the outside of the package to the LED chip. *Id.* Although Petitioner and Dr. Krames assert that a POSITA would have been motivated to include additional fixing holes in the interior portions of the lead frames to secure the encapsulant to the metal lead frame for mechanical integrity and to prevent moisture intrusion (Pet. MTA Opp. 10; Pet. MTA Reply 2; Ex. 1025 ¶ 79), neither Petitioner nor Dr. Krames addresses the additional moisture penetration path that would be created by adding such fixing holes.

Synthesizing our findings regarding motivation to combine Lee and Mahle, we determine that Petitioner has not shown that a POSITA would have viewed the potential benefit identified by Petitioner of more securely attaching the package body to the lead frames as outweighing the detriments identified by Patent Owner, including reduced heat dissipation and an additional path for moisture penetration. Accordingly, we determine that Petitioner has not met its burden to show that a POSITA would have been motivated to combine the teachings of Lee and Mahle in the manner proposed by Petitioner.

***Proposed substitute claims 19 and 22.*** These claims depend from proposed substitute claims 17 and 20, respectively, and recite “a second fixing hole formed in at least one of the interior portions of the first and second lead frames.” PO MTA 19, App. A, 5, 7.<sup>14</sup> The shortcomings in Petitioner’s arguments and evidence for independent claims 17 and 20 are not remedied by its arguments and evidence for dependent claims 19 and 22. On the contrary, for the reasons discussed above, we find that the detriments identified by Patent Owner—reduced heat dissipation and an additional path for moisture penetration—would have been exacerbated by adding a second fixing hole in the interior portions of Lee’s lead frames. For these reasons, we determine that Petitioner has not met its burden to show that proposed substitute claims 19 and 22 are unpatentable as obvious in view of Lee and Mahle.

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<sup>14</sup> As discussed above, we determine patentability of proposed substitute claims 18, 19, 21, and 22 consistent with Patent Owner’s statement that they “depend on substitute claims 17 and 20.” PO MTA 19.

Accordingly, Petitioner has not met its burden to show that proposed substitute claims 17, 19, 20, and 22 are unpatentable as obvious in view of Lee and Mahle.

*8. Petitioner's Challenge Based on Lee, Mahle, and Brunner*

Proposed substitute claims 18 and 21 depend from proposed substitute claims 17 and 20, respectively, and recite “a resin part comprising a phosphor disposed in the fixing space to support the first and second lead frames.” POMTA 19, App. A, 5, 7.<sup>15</sup> Petitioner challenges proposed substitute claims 18 and 21 as obvious based on Lee, Mahle, and Brunner. The shortcomings in Petitioner's arguments and evidence for independent claims 17 and 20 are not remedied by its arguments and evidence for dependent claims 18 and 21, including its arguments and evidence about Brunner. For these reasons, we determine that Petitioner has not met its burden to show that proposed substitute claims 18 and 21 are unpatentable as obvious in view of Lee, Mahle, and Brunner.

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<sup>15</sup> See footnote 14 above.

### III. CONCLUSION

In summary:

| <b>Claims</b>              | <b>35<br/>U.S.C. §</b> | <b>Reference</b> | <b>Claims<br/>Shown<br/>Unpatentable</b> | <b>Claims<br/>Not Shown<br/>Unpatentable</b> |
|----------------------------|------------------------|------------------|------------------------------------------|----------------------------------------------|
| 1–16                       | 102(b) <sup>16</sup>   | Lee              |                                          |                                              |
| 1–16                       | 103(a)                 | Lee              | 1–16                                     |                                              |
| <b>Overall<br/>Outcome</b> |                        |                  | 1–16                                     |                                              |

| <b>Motion to Amend Outcome</b>              | <b>Claims</b>       |
|---------------------------------------------|---------------------|
| Original Claims Cancelled by Amendment      |                     |
| Substitute Claims Proposed in the Amendment | 17–22 <sup>17</sup> |
| Substitute Claims: Motion to Amend Granted  | 17–22               |
| Substitute Claims: Motion to Amend Denied   |                     |
| Substitute Claims: Not Reached              |                     |

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<sup>16</sup> As discussed in Section II.F. above, we do not reach the anticipation ground challenging claims 1–16, as we determine that those claims are unpatentable based on the obviousness ground, as noted in the table.

<sup>17</sup> As discussed in Section II.G.2. above, Patent Owner’s claim listing in Appendix A of the Motion to Amend does not include substitutes for dependent claims 3–5, 7, 8, 11–13, 15, and 16 to change their dependency, and this omission appears to be unintentional. PO MTA 19. If Patent Owner wishes to correct this omission, then it should meet and confer with Petitioner and request a conference call with the Board to seek authorization to file a replacement claims appendix.

#### IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–16 of the '967 Patent are unpatentable;

FURTHER ORDERED that Patent Owner's Contingent Motion to Amend is *granted* as to proposed substitute claims 17–22; and

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

IPR2020-00410  
Patent 10,134,967 B2

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