

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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SILERGY CORPORATION,  
Petitioner,

v.

MONOLITHIC POWER SYSTEMS, INC.,  
Patent Owner.

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Case IPR2015-00804  
Patent 8,361,899 B2

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Before MICHAEL R. ZECHER, CHRISTOPHER L. CRUMBLEY, and  
DANIEL J. GALLIGAN, *Administrative Patent Judges*.

CRUMBLEY, *Administrative Patent Judge*.

FINAL WRITTEN DECISION  
35 U.S.C. § 318 and 37 C.F.R. § 42.73

## I. INTRODUCTION

In this *inter partes* review trial, instituted pursuant to 35 U.S.C. § 314, Petitioner Silergy Corporation challenges the patentability of claims 1–8 and 10 of U.S. Patent No. 8,361,899 B2 (“the ’899 patent,” Ex. 1001), owned by Monolithic Power Systems, Inc.

We have jurisdiction under 35 U.S.C. § 6(b). This Final Written Decision, issued pursuant to 35 U.S.C. § 318(a), addresses issues and arguments raised during trial. For the reasons discussed below, we determine that Silergy has proven, by a preponderance of the evidence, that claims 1–8 and 10 of the ’899 patent are unpatentable.

### A. Procedural History

On February 24, 2015, Silergy requested an *inter partes* review of claims 1–8, 10, and 11 of the ’899 patent. Paper 1, “Pet.” Monolithic filed a Patent Owner Preliminary Response. Paper 6. In a Decision on Institution of *Inter Partes* Review, we instituted trial as to claims 1–8 and 10, but denied institution as to claim 11. Paper 10, “Dec. on Inst.” Trial was instituted on the following grounds of unpatentability:

1. Whether claims 1–5 and 10 are unpatentable under 35 U.S.C. § 102(e) as anticipated by Sirinorakul;<sup>1</sup>
2. Whether claims 6 and 7 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over Sirinorakul;

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<sup>1</sup> U.S. Patent No. 8,129,229 B1 (filed Dec. 2, 2010) (Ex. 1004).

3. Whether claims 6 and 7 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over Sirinorakul and Eslamy;<sup>2</sup> and
4. Whether claim 8 is unpatentable under 35 U.S.C. § 103(a) as having been obvious over Sirinorakul and Khor.<sup>3</sup>

Dec. on Inst. 23–24.

Following institution of trial, Monolithic filed a Patent Owner Response (Paper 12, “PO Resp.”), and Silergy filed a Reply (Paper 14, “Pet. Reply”).

Silergy supported its Petition with the Declaration of R. Jacob Baker, Ph.D. (Ex. 1003), and with its Reply submitted a Reply Declaration of Dr. Baker (Ex. 1026). Monolithic took the cross-examination of Dr. Baker via deposition (Ex. 2002), and submitted Observations on Dr. Baker’s cross-examination (Paper 19), to which Silergy replied (Paper 22). With its Response, Monolithic submitted the Declaration of Joseph C. McAlexander III. Ex. 2001.

Oral hearing was requested by both parties, and a hearing was held May 11, 2016. A transcript of the oral hearing is included in the record. Paper 27, “Tr.”

### *B. The '899 Patent*

The '899 patent, titled “Microelectronic Flip Chip Packages With Solder Wetting Pads and Associated Methods of Manufacturing,” issued January 29, 2013, from U.S. Patent Application No. 12/970,784, filed on

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<sup>2</sup> U.S. Patent No. 7,691,670 B2 (issued Apr. 6, 2010) (Ex. 1006).

<sup>3</sup> U.S. Patent No. 6,482,680 B1 (issued Nov. 19, 2002) (Ex. 1008).

December 16, 2010. Ex. 1001, at [54], [45], [21], [22]. As the title suggests, the '899 patent generally relates to microelectronic packages with solder wetting pads and associated methods of manufacturing and operation. *Id.* at 1:8–10. According to the '899 patent, “flip chip” is a method of connecting semiconductor dies to substrates using solder balls in which the solder balls are first attached to the die, the die is flipped over onto the substrate, and then the solder is reflowed to connect the components. *Id.* at 1:14–22. As characterized by the patent, prior art flip chip methods may result in uncontrollable collapse of the solder balls during reflow, leading to excessive spread of solder and undesired contact between portions of the die and substrate, which may result in shorting. *Id.* at 1:23–30.

The '899 patent purportedly addresses this problem by defining certain attachment areas on the lead fingers of a substrate prior to contacting the solder-bearing semiconductor die to the substrate. *Id.* at 3:27–32. The attachment areas have a wetting material, such as silver, nickel, or gold alloy, deposited thereon. *Id.* at 3:32–36. Other areas of the lead fingers are non-attachment areas, which are treated to be less wettable to solder. *Id.* at 3:58–65. The difference in the wettability of the two areas limits migration of solder into the non-attachment areas during reflow, resulting in what the '899 patent terms a “controllable collapse” of the solder balls. *Id.* at 4:10–23. The '899 patent teaches that the wettability differential between the attachment and non-attachment areas can be adjusted based on a target degree of migration of solder, with a larger wettability differential resulting in a smaller degree of migration, and vice versa. *Id.* at 4:27–38.

The '899 patent describes several methods of defining the attachment and non-attachment areas on the lead fingers, including using a photoresist process (*id.* at 2:53–4:57, Fig. 1), screen printing (*id.* at 5:44–62, Fig. 3), or preform (*id.* at 5:63–6:21, Fig. 4). For example, the following steps of a photoresist process are depicted in Figures 1B–1E:

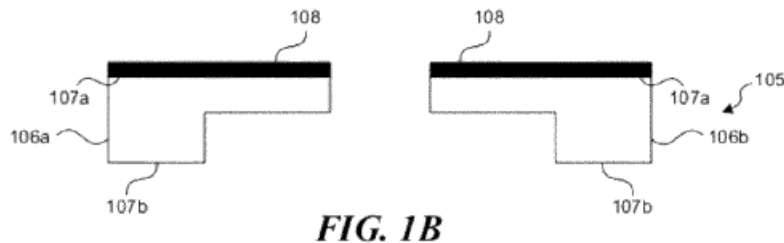


Figure 1B depicts lead frame 105 having lead fingers 106a and 106b. *Id.* at 2:53–67. Masking material 108 comprising a photoresist is deposited on surface 107a of the lead fingers. *Id.* at 3:1–6.

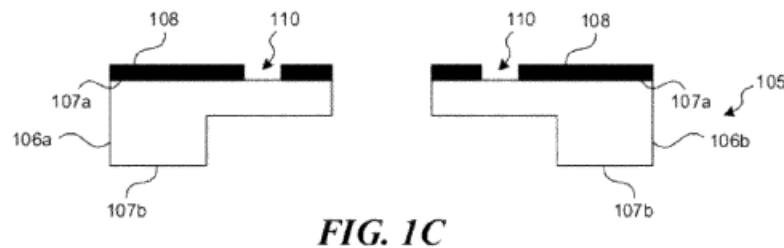


Figure 1C depicts a material removal stage in which portions of masking material 108 are removed to define a plurality of openings 110. *Id.* at 3:18–20. A wetting material is then deposited into openings 110 of the masking material to form attachment areas. *Id.* at 3:30–32.

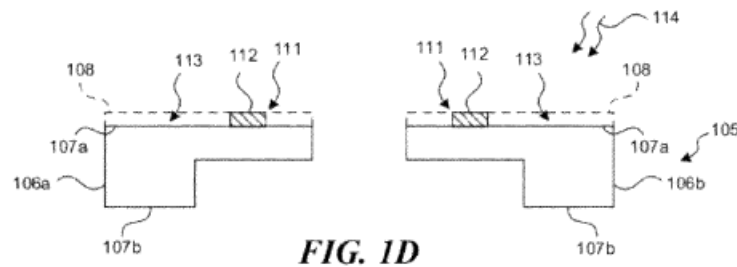


Figure 1D depicts attachment areas 112 formed on surface 107a of lead fingers 106a and 106b, corresponding to openings 110 in Figure 1C. *Id.* at 3:27–32. Remaining masking material 108 is then removed, and non-attachment areas 113 are defined by treating the areas not covered by the wetting material, for example by oxidizing the surface. *Id.* at 3:44–49.

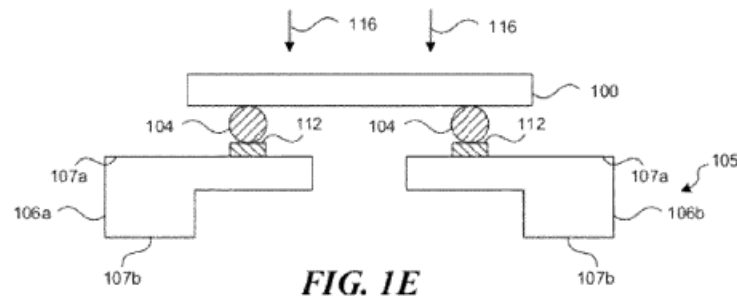


Figure 1E depicts semiconductor die 100 with solder balls 104 being contacted with attachment areas 112 of lead fingers 106a and 106b. *Id.* at 3:66–4:2. The solder can then be reflowed to connect the die to the substrate. *Id.* at 4:2–6.

### C. Illustrative Claim

Of the challenged claims at issue in this trial, claim 1 is the sole independent claim, and is directed to a method for fabricating a

semiconductor assembly. Claims 2–8 and 10 depend from independent claim 1. Independent claim 1 is reproduced below:

1. A method for fabricating a semiconductor assembly, comprising:
  - forming an attachment area and a non-attachment area on a lead finger of a lead frame, the attachment area being more wettable to a solder ball than the non-attachment area during reflow;
  - contacting a solder ball carried by a semiconductor die with the attachment area of the lead finger;
  - reflowing the solder ball while the solder ball is in contact with the attachment area of the lead finger; and
  - controllably collapsing the solder ball to establish an electrical connection between the semiconductor die and the lead finger of the lead frame;
- and wherein the method further includes
  - attaching the solder ball to a contact pad of the semiconductor die;
  - forming the attachment area and the non-attachment area includes:
    - depositing a photoresist on a surface of the lead finger containing copper (Cu);
    - patterning the photoresist to form an opening corresponding to the attachment area, the opening exposing a first portion of the surface of the lead finger, a second portion of the surface being covered by the photoresist;
    - depositing silver (Ag) on the first portion of the surface of the lead finger through the opening in the photoresist;
    - removing the photoresist from the second portion of the surface of the lead finger having the deposited silver; and
    - oxidizing the second portion of the surface of the lead finger thereby forming copper oxide ( $\text{Cu}_x\text{O}$ );

controllably collapsing includes:

preventing the solder ball from migrating away from the silver in the attachment area with the copper oxide in the non-attachment area; and

establishing an electrical connection between the contact pad of the semiconductor die and the lead finger of the lead frame via the solder ball; and

the method further includes at least partially encapsulating the semiconductor die, the solder ball, and the lead finger with an encapsulant.

Ex. 1001, 6:52–7:16 (line breaks added for readability).

## II. ANALYSIS

### A. *Claim Construction*

For purposes of our Decision on Institution, we analyzed each claim term in light of its broadest reasonable interpretation, as understood by one of ordinary skill in the art and consistent with the specification of the '899 patent. 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). In its Petition, Silergy proposed constructions for the claim terms *controllably collapsing*, *migration/migrating*, and *wetting material*. Pet. 13–16. In the Decision on Institution, we determined that, based on the record at the time, no claim term required express construction. Dec. on Inst. 11. We did, however, note that Monolithic's application of the claim term *attachment area* was too narrow, and that the

term could reasonably be understood to cover both a plated layer and a layer of solder covering it. *Id.* at 15.

During trial, the parties continued to dispute the proper construction of the term *attachment area*, and also disputed whether claim 1 requires that the steps of the method be carried out in any particular order. We address these two issues below.

1. *attachment area*

Claim 1 requires a step of “forming an attachment area” on a lead frame. Ex. 1001, 6:53–54. Silergy contends that the broadest reasonable interpretation of this *attachment area* is “the portion of the lead finger that contacts the solder ball and is more wettable to a solder ball than the non-attachment area.” Pet. Reply 5. Monolithic does not proffer an explicit construction of *attachment area*, but contends that it only includes material deposited during the photoresist fabrication step (shown in Figure 1D as wetting material 111), and that anything deposited subsequently cannot be part of forming the *attachment area*. PO Resp. 18–19. Monolithic also contends that, in its Petition, Silergy agreed with its construction, and only changed its construction after the Board’s Decision on Institution. *Id.* at 36–38.

Taking the latter argument first, we note that in exercising our duty to determine the meaning of claim terms at issue, we have “an independent obligation to determine the meaning of the claims, notwithstanding the views asserted by the adversary parties.” *Exxon Chem. Patents, Inc. v. Lubrizol Corp.*, 64 F.3d 1553, 1555 (Fed. Cir. 1995). Therefore, we are not bound by the constructions proffered by the parties; even if the parties in fact

agreed as to the construction of *attachment area*, that would not absolve us from independently considering the issue and making a correct decision as a matter of law. Our Decision to Institute set forth our preliminary determination that *attachment area* should not exclude overlying layers of solder, putting the parties on notice of that construction and permitting both parties to brief the correct interpretation of the term. *Cf. SAS Inst., Inc. v. ComplementSoft, LLC.*, 825 F.3d 1341, 1351 (Fed. Cir. 2016) (Administrative Procedure Act requires sufficient notice to the parties of changed claim construction); *see also Genzyme Therapeutic Prod. Ltd. P'ship v. Biomarin Pharm. Inc.*, 825 F.3d 1360, 1367 (Fed. Cir. 2016) (“The critical question for compliance with the APA and due process is whether [the parties] received “adequate notice of the issues that would be considered, and ultimately resolved, at [the] hearing.””).

Reviewing the parties’ proffered constructions of *attachment area*, we maintain our determination that the term requires no express construction. Starting, as we must, with the language of the claim itself, we note that claim 1 describes several aspects of the *attachment area*. First, the *attachment area* is “more wettable to a solder ball than the non-attachment area.” Ex. 1001, 6:54–56. As Dr. Baker testified, “wettability” means “the ability of molten solder to flow over and adhere to a surface,” and that, while metals are “generally wettable to solder, . . . oxides of these metals are generally not.” Ex. 1003 ¶ 29. Mr. McAlexander did not dispute this testimony.

Second, claim 1 sets forth a number of subsidiary steps for “forming the attachment area,” including for example “depositing a photoresist on a surface of the lead finger containing copper (Cu)” and “depositing silver

(Ag) on the first portion of the surface of the lead finger through the opening in the photoresist.” Ex. 1001, 6:65–66, 7:3–4. Therefore, the *attachment area* must contain at least silver, deposited on a copper-containing lead finger. We note, however, that the steps of “forming the attachment area” are introduced by the word “includes” (*id.* at 6:63–64), which is an open transitional phrase synonymous with “comprises.” *In re Bertsch*, 132 F.2d 1014, 1019 (CCPA 1942); *Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1345 (Fed. Cir. 2003). For this reason, forming the attachment area may also involve other steps that result in the deposition of additional materials beyond silver. The specification of the ’899 patent supports this interpretation, noting that the “wetting material can include silver (Ag), a nickel (Ni)/gold (Au) alloy, and/or other suitable metal or metal alloys that exhibit first wetting characteristics with regard to the electrical couplers during reflow.” Ex. 1001, 3:32–36 (internal numbering omitted).

Neither party’s proposed construction adds clarity to the term beyond that provided by the express language of claim 1. Silergy’s construction introduces into the term two requirements—“contacts the solder ball” and “more wettable to a solder ball”—that appear elsewhere in claim 1, making their inclusion in the construction redundant. As for Monolithic’s construction, we see no reason to limit the *attachment area* to materials deposited during the photoresist process. As discussed above, the inventor’s use of the word “includes” as a transitional phrase signifies that additional steps may be part of “forming the attachment area and non-attachment area,” even after the photoresist process.

For these reasons, we reconfirm our determination in the Decision on Institution that the language of claim 1 is sufficiently clear, and that the term *attachment area* requires no express construction.

## 2. Order of Steps

Monolithic contends that the steps of claim 1—in particular, the steps of *forming*, *contacting*, and *reflowing*—“must be interpreted in the exact order written.” PO Resp. 13. Silergy disagrees, arguing that “nothing in the intrinsic record requires such a rigid order of execution.” Pet. Reply 13.

“Although not every process claim is limited to the performance of its steps in the order written, the language of the claim, the specification and the prosecution history” may in some instances compel a particular order. *Loral Fairchild Corp. v. Sony Corp.*, 181 F.3d 1313, 1322 (Fed. Cir. 1999). First, the claim language must be examined “to determine if, as a matter of logic or grammar, they must be performed in the order written.” *Altiris, Inc. v. Symantec Corp.*, 318 F.3d 1363, 1369 (Fed. Cir. 2003). If not, we look to the specification and prosecution history to determine whether an order is directly or implicitly required. *Id.*

Monolithic argues that the *forming* step of the claim must be performed before the other steps because the attachment and non-attachment areas must pre-exist on the lead finger before the solder ball is contacted to them. PO Resp. 13. “Otherwise, the lead finger of the lead frame would not have a target location for attaching a solder ball.” *Id.*; *see also* Tr. 72:4–7 (“[T]he forming has to occur before the contacting, because you need to form the attachment area before you can contact the attachment area with the solder ball.”).

On this point, we agree with Monolithic. As a matter of logic, the formation of the *attachment area* must be performed before the area can be contacted with the solder ball. See *Loral Fairchild*, 181 F.3d at 1321 (explaining that the step of aligning a barrier region with an insulation layer must be performed after the step of forming the insulation layer).

Regarding the *contacting* and *reflowing* steps, however, we disagree with Monolithic's required order. Monolithic contends that the claim language—that the *reflowing* occurs “while the solder ball is in contact”—requires a “pre-existing condition” that “the solder ball is in contact with the attachment area of the lead finger, which is a result of the ‘contacting’ step.” PO Resp. 14 (emphasis omitted). If “reflowing” were an instantaneous process, this may be the case. The record, however, establishes that “reflowing” refers to a condition that may exist over a period of time; namely, the period during which the application of heat to the solder causes the solder to be in a liquid form. Dr. Baker testified that “reflowing” solder is “applying sufficient heat so that the solder melts to form an electrical connection between the die and the substrate.” Ex. 1003 ¶ 39. While Mr. McAlexander did not present a competing definition, at oral hearing Monolithic's counsel articulated a definition consistent with Dr. Baker's testimony. Tr. 79:13–15 (“I would submit to you that reflowing is heating and melting and the reflowing process stops when it forms rigidity.”).

With this understanding that the *reflowing* step may take place over a period of time, claim 1's requirement that the reflowing happens “while the solder ball is in contact” implies only that the *contacting* step must take place prior to, or sometime during, the period that the solder is in liquid

form. The only order of steps required by the claim language itself is that the *contacting* must occur before *reflowing* has ended (i.e., before the solder returns to a solid state). Nor do we discern any portion of the specification that requires a contrary interpretation. Instead, as pointed out by Silergy, the '899 patent states that in flip-chip processes the solder balls may be aligned—but not necessarily contacted—with their connection sites on the substrate, and contact (“interconnection”) is only completed when reflow occurs. Pet. Reply 14 (citing Ex. 1001, 1:14–22). Nothing in the specification states that contact between the solder ball and the attachment area is required prior to beginning the reflow process, as Monolithic contends.

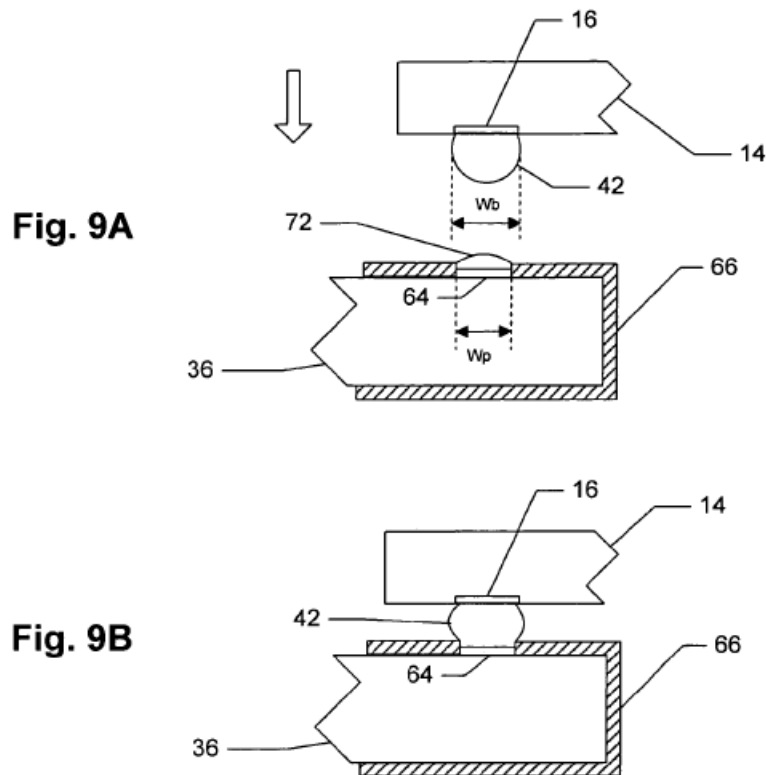
For these reasons, we interpret claim 1 as requiring the *forming* step to occur prior to the *contacting* step, but the *contacting* step may take place before, or during, the *reflowing* step.

*B. Anticipation by Sirinorakul*

Silergy contends that claims 1–5 and 10 are unpatentable under 35 U.S.C. § 102(e) as anticipated by Sirinorakul. Pet. 17–35. To establish anticipation, Silergy must prove that each and every element in a claim is found in Sirinorakul, arranged as recited in the claim. *See Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008); *Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F.3d 1376, 1383 (Fed. Cir. 2001). We first summarize the disclosure of Sirinorakul, followed by an analysis of the parties’ arguments regarding anticipation.

1. Sirinorakul

Sirinorakul describes a flip-chip method of manufacturing a semiconductor package. Ex. 1004, 1:16–27. Figures 9A and 9B of Sirinorakul, reproduced below, illustrate a method of connecting a semiconductor chip to a leadframe. *Id.* at 4:32–52.



As shown in Figure 9A, chip 14 has solder ball 42 attached to bonding pad 16, while leadframe 36 has plated layer 64 surrounded by oxide layer 66. *Id.* at 4:32–37. Plated layer 64 may be a metal, such as silver or an alloy, deposited using a photoresist mask to cover the remainder of the leadframe. *Id.* at 3:60–61. Sirinorakul discloses that the plated layer has layer 72 of lead-free solder placed thereon. *Id.* at 4:37–38. Figure 9B

depicts the joining of chip 14 to leadframe 36 using solder ball 42, which “remains in a tight configuration and [does] not spread out.” *Id.* at 4:42–47.

## 2. *Analysis of Anticipation*

In our Decision on Institution, we found reasonable Silergy’s contention that Sirinorakul discloses the steps of claims 1–5 and 10, expressly or inherently. For example, Silergy contends that the method described above and depicted in Figures 9A and 9B discloses forming attachment and non-attachment areas, with the attachment area being more wettable to solder during reflow. Pet. 21. According to Silergy, Sirinorakul also discloses contacting a solder ball carried by a semiconductor die with the attachment area. *Id.*

Sirinorakul does not disclose expressly the subsidiary photoresist-related steps defined under the “forming the attachment area and the non-attachment area” portion of claim 1. In our Decision on Institution, however, we credited Dr. Baker’s testimony that Sirinorakul’s reference to a “photoresist mask” would have been understood by a person of ordinary skill in the art to refer to a well-known photoresist process, which necessarily includes the depositing, patterning, and removing steps of claim 1. Dec. on Inst. 15; Ex. 1003 ¶¶ 33, 62–64.

During trial, the parties’ dispute focused on whether Sirinorakul disclosed the *contacting* step of claim 1, and whether the step took place, if at all, at the required point in the process. At oral hearing, Monolithic’s counsel confirmed that the remaining limitations were not in dispute. Tr. 59:17–22. In light of this fact, and having reviewed the entire record introduced during trial, we reaffirm our findings from the Decision on

Institution regarding the non-disputed elements of claim 1 and adopt Silergy's analysis of these elements. We, therefore, turn to the disputed *contacting* element of claim 1.

Silergy contends that Sirinorakul discloses contacting a solder ball with an attachment area, as required by claim 1. Pet. 18. To support this contention, Silergy directs us to Figure 9 of Sirinorakul (reproduced above), which first depicts in Figure 9A a “chip 14 with lead-free solder ball 42 attached to bonding pad 16 . . . approaching leadframe 36,” followed in Figure 9B by the solder ball 42 in contact with plated layer 64 “during the reflow process.” *Id.* (citing Ex. 1004, 4:33–42). Silergy argues that plated layer 64 covered with lead-free solder 72 is an *attachment area*, because both the plated layer and the lead-free solder are “wetting materials.” Pet. Reply 21; Ex. 1003 ¶ 52 (Dr. Baker: “[W]etting material’ must help make the attachment areas more wettable to solder . . . ‘wetting material’ must at least include solder itself.”). Based on the record at trial, including Dr. Baker’s testimony, we agree that both the plated layer and the lead-free solder layer of Sirinorakul are more wettable to solder than the surrounding oxide layer.

Monolithic makes two arguments in response. First, Monolithic contends that the lead-free solder of Sirinorakul cannot be considered part of the *attachment area*. PO Resp. 20–23. As such, Monolithic argues, the Sirinorakul method cannot meet claim 1’s requirement of “contacting a solder ball carried by a semiconductor die with the attachment area of the lead finger,” because Sirinorakul’s solder ball 42 contacts lead-free solder 72, not plated layer 64. *Id.* Second, Monolithic argues that Sirinorakul

shows a different order of steps than that required by claim 1 because it only shows contact between the solder ball and the plated layer *during* reflow, as opposed to beforehand. *Id.* at 24–36.

Taking the latter argument first, Monolithic’s contentions lack merit in view of our conclusion regarding the order of the steps of claim 1. Monolithic’s argument is premised on its contention that in claim 1, the contacting must occur before reflowing begins. As discussed above, the language of claim 1 permits the *contacting* step to take place before, or during, the *reflowing* step. Figure 9B of Sirinorakul depicts contact between plated layer 64 and solder ball 42 “during the reflow process.” Ex. 1004, 4:42. Monolithic does not dispute that plated layer 64 is an *attachment area*; nor does it dispute that there is contact with solder ball 42 during reflow. Tr. 76:7–17 (“[I]n each of those figure Bs in the embodiments disclosed in the [Sirinorakul] prior art reference, it shows *during the reflow process*. . . . Here it’s showing the contact occurs *during reflow*.”) (emphasis added). Even if lead-free solder layer 72 is not part of the attachment area—an argument we address below—Figure 9B of Sirinorakul does not show solder layer 72 during reflow, or that there is any other object blocking contact between plated layer 64 and solder ball 42. We, therefore, find the disputed *contacting* step to be satisfied because plated layer 64 (the *attachment area*) contacts solder ball 42 during reflow.

At oral hearing, Monolithic’s counsel also presented an argument that Sirinorakul does not disclose the *contacting* step because the claims of the reference only discuss “bringing the solder ball in proximity, not in contact” before reflow occurs, and then it is the reflow itself that causes contact. Tr.

75:1–3. Even if this argument somehow distinguishes the *claims* of Sirinorakul over claim 1 of the '899 patent, we find the full disclosure of the reference discloses the contacting step, as set forth above. Furthermore, even if such an argument were persuasive, we note that it does not appear in Monolithic's briefs and was raised for the first time at oral argument, and thus will not be considered. *Dell Inc. v. Acceleron, LLC*, 818 F.3d 1293, 1301 (Fed. Cir. 2016) (finding that factual assertion raised for the first time at oral argument deprives other party of notice and opportunity to respond); 37 C.F.R. § 42.70(a) (permitting oral argument only on "an issue raised in a paper.").

Although claim 1's *contacting* step is met regardless of whether Sirinorakul's lead-free solder layer 72 is part of the *attachment area*, we also do not agree with Monolithic's argument on this point. According to Monolithic, the lead-free solder layer of Sirinorakul is deposited as part of the process of attaching the die to the substrate, as opposed to the process of forming the die itself. PO Resp. 20–23. To support this argument, Monolithic directs us to Sirinorakul's "Brief Summary of the Invention" section, which describes forming the plated layer in a first paragraph and the use of a layer of lead-free solder in a second paragraph. *Id.* at 21 ("The first paragraph discloses forming the attachment area and the non-attachment area, and the second paragraph discloses using the attachment area . . . in a number of flip-chip attach processes."). Citing the testimony of Mr. McAlexander, Monolithic argues that "all additional materials added to the plated area or the solder ball, including a lead-free layer and a solder flux are all part of the flip-chip attach processes rather than part of the attachment

area and non-attachment area forming process.”<sup>4</sup> *Id.* at 22 (citing Ex. 2001 ¶ 34) (emphasis omitted).

We do not agree with this argument, as it ignores the open nature of the claim’s recitation of the steps of forming the attachment area. First, Sirinorakul does not make the bright-line distinction between “forming an attachment area” and “attach processes” that Monolithic implies; indeed, it does not use the term “attachment area” at all. Second, as discussed above, claim 1 requires certain steps to be performed, but does not exclude additional steps. Thus, we disagree with Mr. McAlexander’s testimony that “forming of the attachment area ends after depositing the wetting material such as silver.” Ex. 2001 ¶ 32 (internal numbering omitted). While Mr. McAlexander is correct that the ’899 patent does not disclose additional material being added as part of forming the attachment area, it does not exclude other conventional steps known in the art, either. Based on the evidence before us, Sirinorakul’s plated layer 64 covered by lead-free solder layer 72 would meet claim 1’s requirement of being “more wettable to a solder ball than the non-attachment area during reflow,” (see Ex. 1003 ¶ 52) and, therefore, properly accounts for the *attachment area* recited in claim 1.

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<sup>4</sup> Monolithic’s counsel also argued at oral hearing that the ’899 patent describes the use of solder masks in the Background of the Invention as a “conventional solution” prior art process, and contended that the ’899 patent should be understood to pertain to processes “without using solder-related processing steps” like those in Sirinorakul. Tr. 61–62. Again, this argument was raised for the first time at oral hearing and does not appear in Monolithic’s briefing. We will not consider it, as Silergy has had no opportunity to respond. *Dell*, 818 F.3d at 1301; 37 C.F.R. § 42.70(a).

For these reasons, even if we were to agree with Monolithic that *contacting* the solder ball with an attachment area must occur prior to *reflowing*, we would determine that Sirinorakul discloses contacting its solder ball 42 with its attachment area (plated layer 64 and lead-free solder 72). We, therefore, find that all elements of claim 1 are disclosed by Sirinorakul.

With respect to the additional limitations of dependent claims 2–5 and 10, Silergy sets forth in its Petition how these are disclosed by Sirinorakul. Pet. 24–29. Monolithic does not dispute the disclosure of Sirinorakul as to these limitations, instead relying on its argument regarding claim 1. PO Resp. 39 (arguing that, “[b]ecause Sirinorakul fails to disclose the features recited in claim 1 and thus fails to anticipate claim 1, Sirinorakul likewise fails to disclose features in claim 1’s dependent claims 2–5 and 10.”).

Based on our review of the record as a whole, the preponderance of the evidence supports Silergy’s contentions as to dependent claims 2–5 and 10. We, therefore, adopt Silergy’s analysis of these claims as set forth in the Petition and find that Sirinorakul discloses the additional elements of claims 2–5 and 10.

### *C. Obviousness over Sirinorakul*

Silergy contends that claims 6 and 7 are unpatentable under § 103(a) as having been obvious over Sirinorakul. Pet. 35–38. Claims 6 and 7 differ from claim 1 in that it is the non-attachment area that is exposed during the photoresist process, rather than the attachment area. Silergy explains that a person of ordinary skill, given Sirinorakul’s disclosure of a photoresist mask, would have found it obvious to reverse which area of the leadframe is

exposed during the treatment process. Pet. 36. Dr. Baker testifies in support of this contention, stating that the variation would have been obvious and predictable, and easily within the abilities of the ordinarily skilled artisan. Ex. 1003 ¶ 87. In our Decision on Institution, we were persuaded by Silergy's explanations and supporting evidence as to claims 6 and 7. Monolithic does not dispute that the additional limitations of dependent claims 6 and 7 would have been obvious to a person of ordinary skill in the art, instead relying on its argument that Sirinorakul does not disclose the *contacting* step of claim 1. PO Resp. 40–41.

We have reviewed Silergy's undisputed evidence as to claims 6 and 7, and we determine that a preponderance of the evidence supports Silergy's position. Although Sirinorakul does not disclose the modified photoresist process required by claims 6 and 7, we credit Dr. Baker's unchallenged testimony that it would have been within the level of ordinary skill in the art to modify a photoresist process to mask the non-attachment area instead, and that the skilled artisan would have recognized this as a predictable variation. Ex. 1003 ¶ 36. Mr. McAlexander does not provide testimony to the contrary. Ex. 2001 ¶ 52.

Although it does not address the merits of the obviousness ground, Monolithic instead generally contends that Silergy failed to prove obviousness, as it did not address all factors set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). PO Resp. 41–43. We disagree. As set forth above, Silergy and Dr. Baker set forth the scope and content of Sirinorakul; the differences between Sirinorakul and claims 6 and 7 (namely, the reversal of the photoresist masking); and the level of ordinary skill in the

art (see Ex. 1003 ¶¶ 26–27). Neither party introduced evidence of objective indicia of nonobviousness. Consequently, Monolithic’s argument on this point lacks merit.

Finally, Monolithic makes a generalized statement that Silergy has failed to meet its burden of proof because the Patent Owner Response and Mr. McAlexander’s testimony “has rebutted each [of] Petitioner’s invalidity argument[s]” and Mr. McAlexander “has provided . . . detailed analyses of Sirinorakul and the 899 Patent and his expert opinions on all the issues in Petitioner’s proposed Ground 1 and has rebutted the positions stated in the Baker Declaration.” PO Resp. 43–44. To the extent this is an attempt to incorporate by reference arguments from Mr. McAlexander’s testimony, it is improper as contrary to the Board’s Rules. 37 C.F.R. § 42.6(a)(3) (“Arguments must not be incorporated by reference from one document into another document.”). To the extent any rebuttals of Silergy’s positions were made in Monolithic’s briefs, we have discussed them herein.

The record at trial establishes by a preponderance of the evidence that claims 6 and 7 would have been obvious over Sirinorakul.

#### *D. Obviousness over Sirinorakul and Eslamy*

Silergy contends that—in the event that Sirinorakul does not, on its own, render claims 6 and 7 obvious—these dependent claims would have been obvious over the combined disclosures of Sirinorakul and Eslamy. Pet. 38–40. As discussed above, claims 6 and 7 require that the non-attachment area is unmasked first during the photoresist process and subsequently oxidized. Eslamy discloses that portions of a lead finger may be selectively oxidized by first masking selected portions and oxidizing only

the unmasked portions. Ex. 1006, 2:41–47. Silergy contends that a person of ordinary skill in the art would have had reason to combine the disclosures of Sirinorakul and Eslamy because both references describe flip-chip manufacturing processes and are concerned with preventing solder spread during reflow, and “treating Sirinorakul’s leadframe in the manner taught by Eslamy is merely using a combination of known prior art elements and techniques to yield predictable results.” Pet. 39–40.

As with the previous obviousness ground, Monolithic does not address the disclosure of the secondary reference or whether the combination with Sirinorakul is proper. Rather, Monolithic relies on its arguments regarding claim 1, and repeats its generalized arguments regarding the *Graham* factors and Mr. McAlexander’s rebuttal of Dr. Baker. PO Resp. 45–47.

We have reviewed Silergy’s unchallenged contentions setting forth how all elements of claims 6 and 7 are disclosed in Sirinorakul and Eslamy, and we find that they are supported by a preponderance of the evidence. Silergy has also provided articulated reasoning with rational underpinning for the combination. See Pet. 39–40. Thus, we find that a person of ordinary skill in the art would have combined the method of Sirinorakul with the masking technique of Eslamy. For these reasons, the record at trial establishes by a preponderance of the evidence that claims 6 and 7 would have been obvious over Sirinorakul and Eslamy.

*E. Obviousness over Sirinorakul and Khor*

Claim 8 depends from claim 1, and requires that forming the attachment and non-attachment areas includes placing a stencil with

openings corresponding to the attachment area on the lead finger and printing a wetting material through the opening in the stencil. Ex. 1001, 8:27–27. Silergy contends that this additional limitation is disclosed by Khor. Pet. 40–41. Khor discloses a “well-known prior art stencil-printing process to print a wetting material . . . onto the surface of a lead frame through stencil openings.” Ex. 1008, 3:66–4:4. Relying on *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 401 (2007), Silergy contends that stencil printing is a known method that could be applied to the method of Sirinorakul to yield predictable results and, therefore, would have been obvious. Pet. 41.

As with the prior obviousness grounds, Monolithic does not address the disclosure of the secondary reference or whether the combination with Sirinorakul is proper. Rather, Monolithic relies on its arguments regarding claim 1, and repeats its generalized arguments regarding the *Graham* factors and Mr. McAlexander’s rebuttal of Dr. Baker. PO Resp. 47–49.

We have reviewed Silergy’s unchallenged contentions setting forth how all elements of claim 8 is disclosed in Sirinorakul and Khor, and we find that they are supported by a preponderance of the evidence. Silergy has also provided articulated reasoning with rational underpinning for the combination. See Pet. 41. Thus, we find that a person of ordinary skill in the art would have combined the method of Sirinorakul with the stencil-printing process of Khor. For these reasons, the record at trial establishes by a preponderance of the evidence that claim 8 would have been obvious over Sirinorakul and Khor.

### III. CONCLUSION

For the foregoing reasons, based on a review of the complete record developed during trial, we conclude that Silergy has proven, by a preponderance of the evidence, that claims 1–8 and 10 of the '899 patent are unpatentable.

### IV. ORDER

Accordingly, it is:

ORDERED that claims 1–8 and 10 of U.S. Patent No. 8,361,899 B2 are *unpatentable*;

FURTHER ORDERED that, pursuant to 35 U.S.C. § 318(b), upon expiration of the time for appeal of this decision, or the termination of any such appeal, a certificate shall issue canceling claims 1–8 and 10 of U.S. Patent No. 8,361,899 B2; and

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

IPR2015-00804  
Patent 8,361,899 B2

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