

UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

NXP USA, INC.,

Petitioner,

v.

BELL SEMICONDUCTOR, LLC,

Patent Owner

Case: IPR2024-00168

U.S. Patent No. 7,345,245

PATENT OWNER'S RESPONSE

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Exhibit	Description
2001	Expert Declaration of Dr. Joseph Bernstein in Support of Patent Owner's Preliminary Response
2002	Disclaimer in a Patent Under 37 CFR 1.321(a) for US Patent No. 7,345,245
2003	Expert Declaration of Dr. Joseph Bernstein in Support of Patent Owner's Response
2004	August 15, 2024 Deposition Transcript of R. Jacob Baker, Ph.D.
2005	William Strunk, Jr., et al., <i>The Elements of Style</i> , 4 th Ed. 94-95 (2000)
2006	Declaration of Christopher Clayton

This Patent Owner's Response is submitted pursuant to 37 C.F.R. § 42.120 in IPR2024-00168 concerning U.S. Patent No. 7,345,245 (the "'245 Patent").

I. INTRODUCTION

Claims 1–6, and 8 of the '245 Patent (the "Challenged Claims") recite a semiconductor package for a die with improved reliability under thermal cycling conditions. In its Institution Decision (Paper 10 at 10), the Board correctly observed that the "parties' arguments appear to depend on different meanings" as it related to certain claim terms. It is abundantly clear that, when properly construed, the Challenged Claims are patentable over the cited art because, among other things, none of the cited art (alone or in combinations proposed by Petitioner) provides a methodology for routing signal traces through or around a high stress area associated with ball pads within two ball pad pitches of the corner of the die.

II. BACKGROUND

A. The '245 Patent

The '245 Patent relates to a semiconductor package for a die with improved thermal cycling reliability. (EX1001, Abstract; EX2003, ¶48.) The development of the semiconductor package claimed in the '245 Patent represented an important advancement related to the design of a semiconductor device. (EX2003, ¶49.) Specifically, the '245 Patent discloses an improved signal trace routing in the high stress area under the die corner that accommodates a range of die sizes. (EX1001

at 2:36–39; EX2003, ¶50.) This responds to the increased demand for high density signal routing on organic BGA substrates and the adoption of full area ball arrays to reduce the package body size and provide a high input/output (IO) signal density. (*Id.* at 1:8–13; EX2003, ¶51-52.) In the prior art, signal traces on the bottom routing layer were routed over the ball pads of the underlying layer. (*See id.* at 1:24–26, 1:57–58; EX2003, ¶53.) The die corner is associated with a surrounding area of high stress, which also affects the ball pads positioned under the area. (EX2003, ¶54.) Edges of those ball pads act as stress concentration points and, under temperature cycling conditions, cracks are initiated from the edges of the ball pads and extend into the dielectric layer above. (*Id.* at 1:58–65; EX2003, ¶55.)

Existing solutions are not sufficient to avoid trace cracks in the signal traces under temperature cycling conditions for all packaging technologies. (*See id.* at 2:16–18; EX2003, ¶56-58.)

Anand Govind, Zafer Kutlu, and Farshad Ghahghahi (“the ’245 Inventors”), understood these issues and set out to develop an improved semiconductor package that eliminates the occurrences of cracks in the signal traces. (EX2003, ¶59.) The ’245 Inventors ultimately conceived of a methodology for signal trace routing in the high stress area under the die corner that accommodates a range of die sizes.

(*Id.* at 2:36–39; EX2003, ¶60.) One such embodiment of the invention provides an improved package in which a high stress area associated with the die corner is defined as an area within two ball pad pitches of the die corner and in which the signal traces are routed so as to preferably be outside the high stress area or, if they cannot be moved outside the high stress area, to avoid being over ball pads within the high stress area. (*Id.* at 2:32–36; 3:45–50; EX2003, ¶61.)

B. Cited Art

The Petition cites the following art:

1. '245 Patent (Purported “AAPA”) (EX1001)

FIGS. 1–3 of the '245 Patent are labeled “prior art” and show a full area ball array package described in the Background of the Invention as “currently in wide use.” (EX1001 at 1:23–2:2; EX2003, ¶62.) The prior art full area ball array package design is described as a “multi-layer organic BGA flip chip substrate that uses a 9-layer stackup 20 with a thin core,” in which “[n]umerous signal traces 36 and other metal structures extend across the layer L8 proximate the die corner 38a” and “[t]he signal traces 36 of layer L8 are routed over the ball pads 34 of layer L9.” (*Id.*; EX2003, ¶63.)

The Background of the Invention identifies a problem with such full area ball array packages and two “existing” solutions to the problem. (*Id.* at 1:58–2:15;

EX2003, ¶64.) The problem is that “areas of high stress are associated with the die corner 38a and in particular the ball pads which are positioned under the area surrounding the die corner 38a. The edges of the ball pads 34, which are associated with the die corner 38a act as stress concentration points and under thermal cycling conditions, cracks are initiated from the edges of the ball pads 34 and extend into the dielectric layer above layer L9. If traces 36 are routed or other metal structures are provided on layer L8 over the ball pads 34 associated with the die corner 38a, the cracks can extend through the traces 36 and cause failures due to trace cracks under cycled stress conditions.” (*Id.* at 1:58–2:2; EX2003, ¶65.) The first “existing” solution is to place metal planes on the layer L9 under the die corner. (*Id.* at 2:3–6; EX2003, ¶66.) The second “existing” solution is to define “a circular shaped area with a one (1) millimeter radius using placement of the die corner 38a as the center of the circle” and not routing traces “within the circular region.” (*Id.* at 2:6–15; EX2003, ¶67.)

Neither the problem nor the “existing” solutions are described in the '245 Patent as being in the prior art or known by others. (EX2003, ¶68.) Without providing any analysis or evidence to support its position, Petitioner makes a conclusory allegation that both the problem identified in the '245 Patent and the two “existing” solutions are admitted prior art. (Pet. at 5–8; EX2003, ¶69.)

“While valid prior art may be created by the admissions of a party, these admissions are generally characterized by statements made during prosecution describing certain work as ‘prior art.’” *Abbott Lab. v. Baxter Pharmaceutical*, 334 F.3d 1274, 1279 (Fed. Cir. 2003). Even if certain work is described as “prior art,” “[i]t is necessary to consider everything appellants have said about what is prior art to determine the exact scope of their admission.” *In re Nomiya*, 509 F.2d 566, 571 (C.C.P.A. 1975).

Here, the Background did not state that the problem was known in the prior art, nor did the Background describe the second “existing” solution as “prior art,” and Petitioner has not presented any analysis or evidence to the contrary. (EX2003, ¶70.)

In fact, there is ample evidence that the problem and “existing” solution are not admitted prior art. (EX2003, ¶71.) First, while Applicant clearly labeled the package design in FIGS. 1–3 as “prior art” and described it as being “currently in wide use,” it consciously avoided using similar terminology to describe the problem with the package design and “existing” solutions to the problem. (EX2003, ¶72.) Instead, Applicant merely explained the problem without characterizing it in any way (i.e., without any admission) and referred to the solutions as “existing” (which is not the same as ‘prior art’ or ‘currently in wide use’). (EX2003, ¶73.) The lack

of any admission with respect to the problem and the use of different terminology with respect to the solutions evidence an intent on the part of the Applicant to distinguish these statements in the patent from prior art. (EX2003, ¶74.)

Second, the '245 Patent describes an embodiment of the invention in a way that encompasses the second “existing” solution. (EX2003, ¶75.) For example, in the Abstract, the Applicant describes the invention generally as defining “a high stress area associated with the corner of the dies” and “routing [signal traces] away from the high stress area,” and uses the term “preferably” when describing the embodiment wherein the high stress area is defined as “two ball pitches away from the corner of the die.” (*Id.* at Abstract; EX2003, ¶76.) Similarly, the Objects and Summary of the Invention states “an embodiment of the present invention provides an improved package in which a high stress area associated with the die corner is defined and in which the signal traces are routed away from the high stress areas at the die corner.” (*Id.* at 2:32–39; EX2003, ¶77.) The Detailed Description refers to the invention broadly as a package “in which signal traces are routed away from the high stress area associated with the ball pads and the corner of the die.” (*Id.* at 3:6–9; EX2003, ¶78.) Finally, it should be noted that independent claim 7 of the '245 patent (which was statutorily disclaimed) is in fact broader than the “existing” solution because it does not specify a specific size or shape of the “surrounding area

of increased stress.” (*Id.* at 4:38–48; EX2003, ¶79.) Thus, it is evident that the “existing” solution should not be considered prior art. (EX2003, ¶80.)

- 2. US Patent Pub. 2003/0183919 to Devnani et al. (“Devnani”) (EX1005)**
- 3. US Patent Pub. 2003/0003705 to Chung, et al. (“Chung”) (EX1006)**
- 4. US Patent No. 6,680,530 to Pillai et al. (“Pillai”) (EX1007)**
- 5. Mobile Intel® Celeron® Processor (0.13 μ) in Micro-FCBGA and Micro-FCPGA Packages Datasheet (April 2003) (“Celeron”) (EX1008)**
- 6. U.S. Patent No. 6,172,305 to Tanahashi (“Tanahashi”) (EX1009)**

III. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art (“POSITA”) would have had a minimum of a bachelor’s degree in a field relating to semiconductor packaging, such as mechanical, electrical, or computer engineering, along with at least two years of experience in semiconductor packaging (or additional education substituting for professional experience and/or significant experience in the field substituting for formal education). (EX2003, ¶28.)

IV. CLAIM CONSTRUCTION

Claims in a post-grant review are construed using the same claim construction standard as in a civil action. 37 C.F.R. § 42.100(b). Under this standard, claim terms are generally given their ordinary and customary meaning as

understood by a POSITA at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). The POSITA is deemed to read the claim term in the context of the entire patent, including the specification and prosecution history. *Id.* at 1313–16. Courts depart from the plain and ordinary meaning in only two instances: (1) when a patentee acts as its own lexicographer, and (2) when the patentee disavows the full scope of the claim term in the specification or during prosecution. *Hill-Rom Servs. v. Stryker Corp.*, 755 F.3d 1367, 1371 (Fed. Cir. 2014).

Petitioner does not specify the plain and ordinary meaning of any term and believes “no express constructions of the claims are necessary to assess whether the prior art reads on the challenged claims.” (Pet. at 10; EX2003, ¶81.) Petitioner’s belief is not helpful in resolving the controversy at hand.

Specifically, Petitioner fails to specify the meaning of three claim terms that are critical to this proceeding:

- “wherein none of the signal traces of the bottom routing layer are located over ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die” (Claim 1);
- “area of increased stress defined by the corner of the die” (Claims

7/8); and

- “within two ball pad pitches of the corner of the die” (Claims 1 and 8). (EX2003, ¶82.)

A. “wherein none of the signal traces of the bottom routing layer are located over ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die” (Claim 1)

The term “wherein none of the signal traces of the bottom routing layer are located over ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die” in claim 1 should be construed to mean “wherein the plurality of ball pads includes ball pads disposed in an area within two ball pad pitches of the corner of the die and wherein none of the signal traces of the bottom routing layer are located over the ball pads in the area.” (EX2003, ¶83.)

There is a “heavy presumption” that the terms used in claims “mean what they say and have the ordinary meaning that would be attributed to those words by persons skilled in the relevant art.” *SuperGuide Corp. v. DirectTV Enters.*, 358 F.3d 870, 874 (Fed. Cir. 2004). Grammatically, the phrase “which are disposed in an area within two ball pad pitches of the corner of the die” is a restrictive relative clause that limits the meaning of the noun “ball pads of the ball pad layer.” EX2003, ¶84.). See, e.g., Strunk & White, *The Elements of Style* 94-95 (4th ed.

2000). It is clear that the restrictive relative clause “which are disposed in an area within two ball pad pitches of the corner of the die” modifies the subject “ball pads of the ball pad layer,” at least because the subject “ball pads of the ball pad layer” is immediately antecedent to the restrictive relative clause, there is no other subject next to the restrictive relative clause, and they are written together without any comma between them. (EX2003, ¶85.)

A mapping of the nouns and verbs in the limitation further supports this conclusion because the verb “disposed” is clearly associated with the state of the immediately antecedent noun “ball pads of the ball pad layer,” whereas the verb “located” is clearly associated with the state of the immediately antecedent noun “signal traces.” (EX2003, ¶86.) Thus, the only reading of this limitation that makes sense grammatically is that it requires ball pads of the ball pad layer to be disposed in an area within two ball pad pitches of the corner of the die. (EX2003, ¶87.)

The intrinsic evidence supports the proposed construction. (EX2003, ¶88.) First, the proposed construction is consistent with the stated purpose of the invention to solve a problem arising from “increased demand for high density signal routing,” (EX1001 at 1:8-10), which results in ball pads being disposed in the area surrounding the die corner (e.g., in a full area ball array) to “provide a high

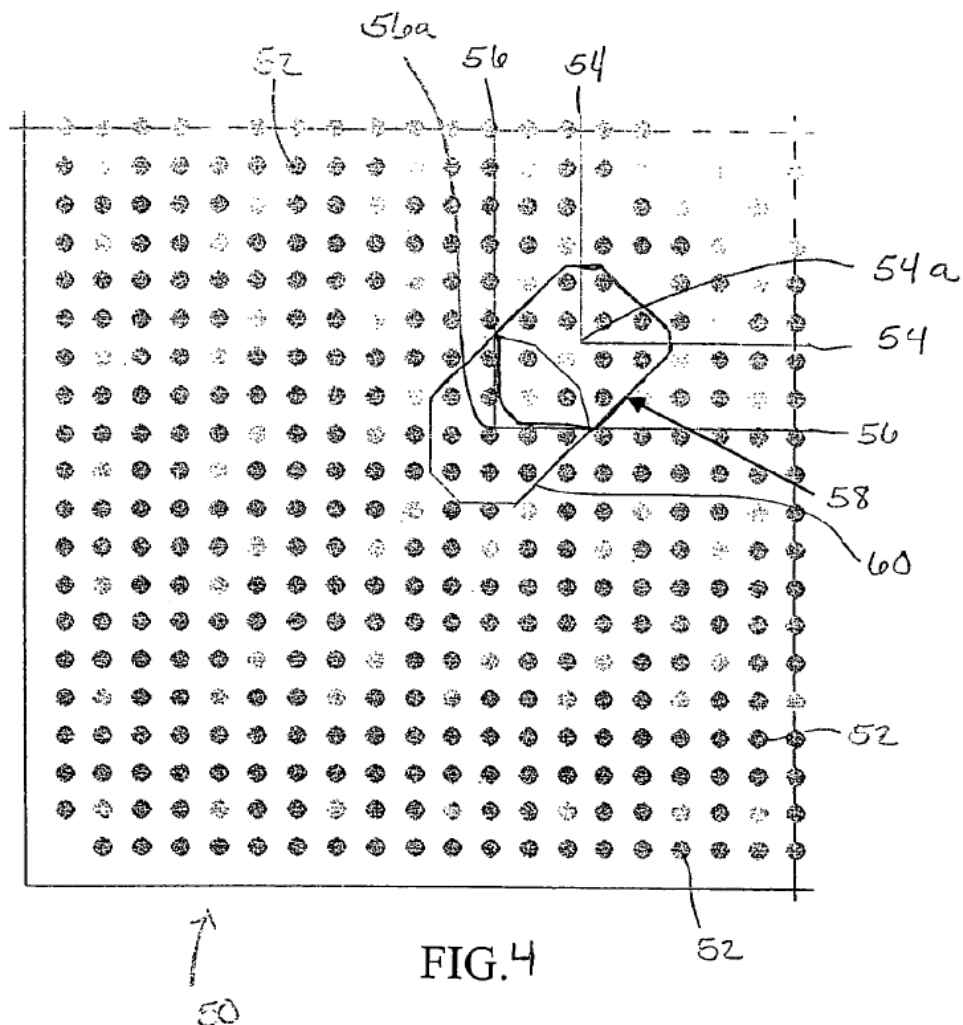
input/output (IO) signal density.” (EX1001 at 1:10–12; EX2003, ¶89.) The ‘245 Patent states that “[p]roblems exist with the packages which are currently in wide use” in which “signals are typically routed directly over the ball pads under the die corner on the bottom routing layer.” (EX1001 at 1:23–26; EX2003, ¶90.) The ‘245 Patent explains that this is a problem because “[a]reas of high stress are associated with the die corner 38a and in particular the ball pads which are positioned under the area surrounding the die corner” and “edges of the ball pads 34 which are associated with the die corner 38a act as stress concentration points and under temperature cycling conditions, cracks are initiated from the edges of the ball pads 34 and extend into the dielectric layer above [the ball pad layer].” (EX1001 at 1:57–64; EX2003, ¶91.) The ‘245 Patent goes on to explain that “[i]f traces 36 are routed or other metal structures are provided on layer L8 over the ball pads 34 associated with the die corner 38a, the cracks can extend through the traces 36 and cause failures due to trace cracks under cycled stress conditions.” (EX1001 at 1:64–2:2; EX2003, ¶92.) Two “existing” solutions are discussed in the ‘245 Patent, together with their disadvantages, and an improved package according to the invention is disclosed. (EX1001 at 2:3–44; EX2003, ¶93.) In light of the specification, the limitation must be construed in the context of solving the problem of reliably routing signal traces in a high density substrate in which ball

pads are disposed in the area around the die corner. (EX2003, ¶94; *see, e.g., AlterWAN, Inc. v. Amazon.com, Inc.*, 63 F.4th 18, 24 (Fed. Cir. 2023) (“In light of the specification, “non-blocking bandwidth” is properly understood to address the problem of latency, rather than providing for bandwidth even in the scenario where the Internet is inoperable.”); *Sequoia Tech., LLC v. Dell, Inc.*, 66 F.4th 1317, 1326 (Fed. Cir. 2023) (“We have explained that a patent's express purpose of the invention “informs the proper construction of claim terms.”).

Second, the specific embodiment described in the ‘245 Patent includes ball pads disposed within the high stress area around the corner of the die. (*See, e.g.,* EX1001 at 3:6-9 (“An embodiment of the present invention provides a substrate package in which signal traces are routed away from the **high stress area** associated with **the ball pads and the corner of the die.**”); EX1001 at 3:28–30 (“Several ball pads 52 are provided within the high stress zone 58 and several ball pads are provided within the high stress zone 60.”); EX1001 at 3:46–50 (“If, however, the traces 64 cannot be moved outside the high stress zone 58, the traces 64 are routed so as to avoid routing the traces 64 over the ball pads 52 of layer L9 within the high stress area 58.”); EX1001 at 3:55–59 (“Because the signal traces 64 and other metal structures are not provided over the ball pads 52, cracks initiated from the ball pad edges during thermal cycling do not affect the traces 64 and other

metal structures and therefore thermal cycling reliability of the package is improved.”); EX2003, ¶95.)

Similarly, in Figure 4 of the ‘245 Patent (reproduced below), several ball pads 52 are illustrated in the high stress areas 58 and 60 surrounding corners 54a and 56a of two dies 54 and 56. (EX2003, ¶96.)



(EX1001 at FIG. 4.)

Thus, Patent Owner's proposed construction comports with the only embodiment shown and described in the '245 Patent. (EX2003, ¶97; *see, e.g., Poly-America, L.P. v. API Indus., Inc.*, 839 F.3d 1131, 1137(Fed. Cir. 2016) ("Every embodiment described in the specification has inwardly extended short seals and every section of the specification indicates the importance of inwardly extended short seals. These two facts provide together a proper reason to limit the claims in this way.")

Third, the '245 Patent disavows embodiments in which there is no high stress area associated with ball pads under the die corner. (EX2003, ¶98.) The illustrated embodiment, in which ball pads are disposed in a high stress zone two ball pad pitches from the die corner in each direction, (EX1001 at 3:26–30), is referred to in the '245 patent as "the present invention," (EX1001 at 2:43–44; EX2003, ¶99.) As opposed to eliminating the high stress area by removing ball pads under the area surrounding the die corner, which would require custom designed high density ball grid arrays for every type of die, the '245 Patent explains that "[t]he *invention* describes a methodology for signal trace routing *in the high stress area* under the die corner that incorporates a range of die sizes," (EX1001 at 2:36–39 (emphasis added); EX2003, ¶100.) The '245 Patent defines "[a]reas of high stress" as those "associated with the die corner 38a and *in*

particular the ball pads which are positioned under the area surrounding the die corner 38a.” (EX1001 at 1:57-59 (emphasis added); *see also* EX1001 at 1:18-21 and 3:6-9; EX2003, ¶101.) By providing a methodology for signal trace routing in the high stress area associated with ball pads under the area surrounding the die corner, the present invention makes it possible to reliably use high density ball grid arrays (i.e., packages with ball pads dispersed throughout the ball pad layer) with dies of various sizes. (EX2003, ¶102.) Such disavowals further confirm the propriety of Patent Owner's proposed construction. (EX2003, ¶103; *see, e.g., Honeywell Int'l, Inc. v. ITT Indus.*, 452 F.3d 1312, 1318 (Fed. Cir. 2006) (“Here, the written description uses language that leads us to the conclusion that a fuel filter is the only ‘fuel injection system component’ that the claims cover, and that a fuel filter was not merely discussed as a preferred embodiment. On at least four occasions, the written description refers to the fuel filter as ‘the invention’ or ‘the present invention.’ . . . The public is entitled to take the patentee at his word and the word was that the invention is a fuel filter.”))

Fourth, embodiments without ball pads under the corner of the die were disavowed during prosecution of the application that issued as the ‘245 Patent, when applicant's attorney expressly argued that “[p]roviding that none of the signal traces of the bottom routing layer are located over *the* ball pads of the ball

pad layer which are disposed in an area within two ball pad pitches of the corner of the die *is the essence of the present invention . . .*,” (EX1004 at 298 (emphasis added); EX2003, ¶104.) By expressly referring to “*the* ball pads . . . which are disposed in a area within two ball pad pitches of the corner of the die” in characterizing “the essence of the present invention,” the applicant confirmed that the invention includes ball pads disposed in an area within two ball pad pitches of the corner of the die, and disavowed packages in which there are no ball pads within two ball pad pitches of the corner of the die. (EX2003, ¶105); *see, e.g., Honeywell Int’l, Inc. v. ITT Indus.*, 452 F.3d at 1318.

For at least these reasons, Patent Owner’s proposed construction of this limitation to mean “wherein the plurality of ball pads includes ball pads disposed in an area within two ball pad pitches of the corner of the die and wherein none of the signal traces of the bottom routing layer are located over the ball pads in the area” is submitted to be correct and should be adopted by the Board. (EX2003, ¶106.)

B. “said die having a corner defining a surrounding area of increased stress” (Claims 7/8)

The term “said die having a corner defining a surrounding area of increased stress” in claim 8 (by virtue of its dependence on statutorily disclaimed independent claim 7) should be construed to mean “said die having a corner

defining a surrounding area of increased stress associated with ball pads under the area.” (EX2003, ¶107.)

As mentioned previously, courts depart from the plain and ordinary meaning of a claim term (1) when a patentee acts as its own lexicographer, and (2) when the patentee disavows the full scope of the claim term in the specification or during prosecution. *Hill-Rom Servs. v. Stryker Corp.*, 755 F.3d at 1371. Here, the ‘245 Patent defines “[a]reas of high stress” as those “*associated with* the die corner 38a and in particular *the ball pads which are positioned under the area surrounding the die corner 38a.*” (EX1001 at 1:57-59 (emphasis added); *see also* EX1001 at 1:18-21 and 3:6-9; EX2003, ¶108.) Petitioner’s expert agreed with the general proposition that a corner with ball pads underneath it has more stress than a corner without:

Q. Well, all other things being the same, would a corner with ball pads under it define a high stress area than a corner without ball pads under it?

MR. TAYLOR: Objection, form.

A. If I understand what you’re asking, I think the answer is yes, you would have more stress in a corner with ball pads than one without. However, it’s very - - it just depends on the - - you know, the sizes and the thicknesses and all that. But, I mean, in general I would say yes, but not always.

(EX2004 at 60:15–61:4; EX2003, ¶109.) Therefore, it is appropriate to construe “area of increased (i.e., high) stress” in accordance with the meaning provided in

the specification of the '245 Patent. (EX2003, ¶110.)

Patent Owner's proposed construction is also correct because the '245 Patent disavows embodiments in which there is no high stress area associated with ball pads under the die corner. (EX2003, ¶111; *see* Section II.A *supra*.) Furthermore, embodiments without ball pads under the corner of the die were disavowed during prosecution. (EX2003, ¶112; *see* Section IV.A *supra*.) Additionally, Patent Owner's proposed construction comports with the only illustrated embodiment of the '245 Patent. (EX2003, ¶113; *see* Section II.A *supra*.) Finally, Patent Owner's proposed construction is correct when viewed in the context of the '245 Patent's purpose of solving the problem of reliably routing signal traces in a high density substrate in which ball pads are disposed in the area around the die corner. (EX2003, ¶114; *see* Section II.A *supra*.)

For at least these reasons, Patent Owner's proposed construction of this limitation to mean "said die having a corner defining a surrounding area of increased stress associated with ball pads under the area" is submitted to be correct and should be adopted by the Board. (EX2003, ¶115.)

C. "within two ball pad pitches of the corner of the die" (Claims 1 and 8)

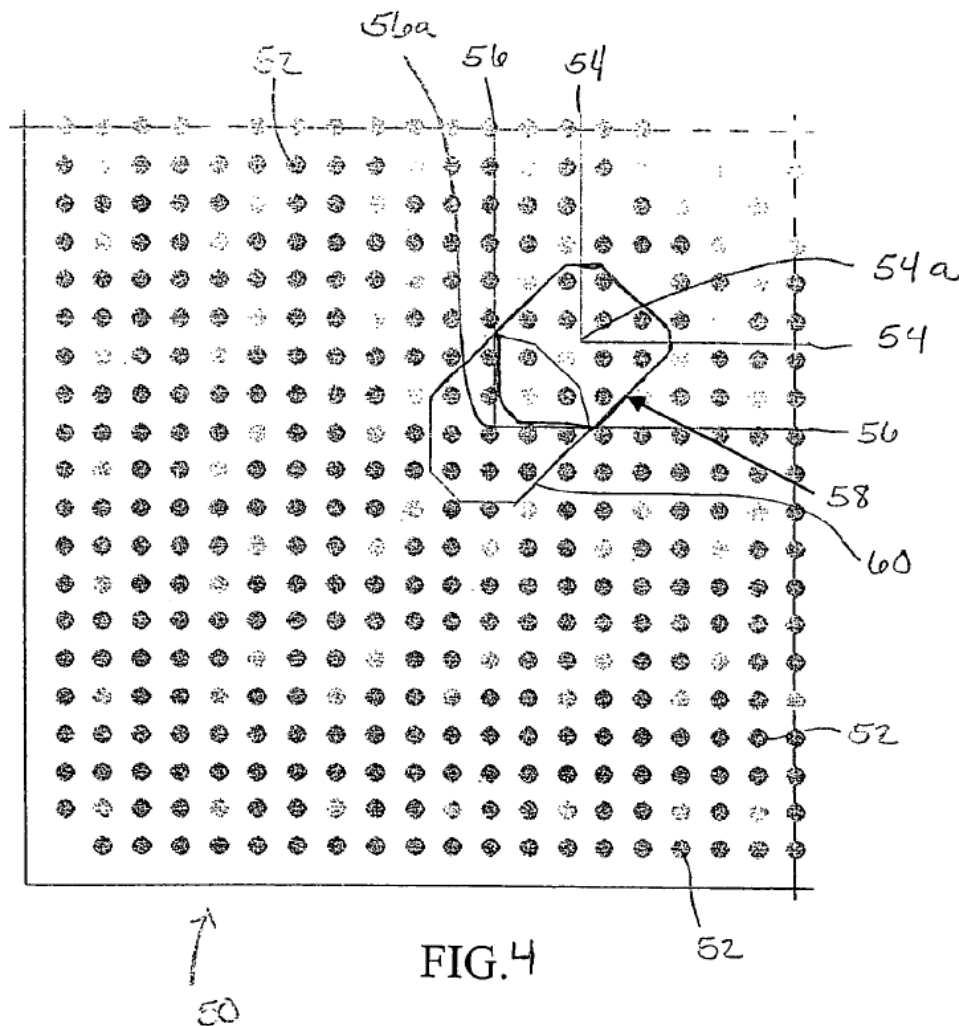
The term "within two ball pad pitches of the corner of the die" in claims 1 and 8 should be construed to mean "within two ball pad pitches of the corner of the

die in each routing direction defined by the ball pads.” (EX1001 at 4:46–51; EX2003 at ¶116.)

As noted above in Section IV, claim limitations should be construed in the context of the purpose of the invention. (EX2003, ¶117; *see, e.g., AlterWAN, Inc.*, 63 F.4th at 24; *Sequoia Tech., LLC*, 66 F.4th at 1326. Here, the purpose of the invention is to solve the problem of reliably routing signal traces in a high density substrate in which ball pads are disposed in the area around the die corner. (EX2003, ¶118; *see* Section II.A *supra.*) The invention solves the problem by defining an area of high stress of a specific size and shape around the die corner and either routing all signal traces outside the high stress area or making sure signal traces routed through the high stress area are not located over the ball pads in the area. (*See, e.g.,* EX1001 at 3:45–50; EX2003, ¶119.) However, to ensure high density signal routing, it is important that the high stress area be no larger than required to eliminate the occurrence of cracks in the signal traces. (EX2003, ¶120.)

As illustrated in FIGS. 4 and 5 of the ‘245 Patent (reproduced below), the aforementioned goal is realized by defining the high stress area as two ball pitches from the corner of the die in each routing direction defined by the ball pads. (EX2003, ¶121.) Routing directions refers to the directions signal traces can be

routed from one ball pad to another ball pad. (EX2003, ¶122.) In the embodiment illustrated in FIGS. 4 and 5, it can be seen that the routing directions defined by the ball pads are horizontal, vertical, and diagonal. (EX2003, ¶123.) That is, signal traces may be routed in a horizontal, vertical, or diagonal direction between two ball pads. (EX2003, ¶124.) More specifically, the disclosed area of high stress extends horizontally from two ball pad pitches to the left of the die corner to two ball pad pitches to the right of the die corner, vertically from two ball pitches below the die corner to two ball pitches above the die corner, diagonally from two ball pad pitches to the northwest of the die corner to two ball pad pitches to the southeast of the die corner, and diagonally from two ball pad pitches to the southwest of the die corner to two ball pad pitches to the northeast of the die corner. (EX2003, ¶125.) The resulting area of high stress is therefore a polygon in the illustrated embodiment. (EX2003, ¶126.)



(EX1001 at FIG. 4.)

By defining the area of high stress as two ball pad pitches from the die corner in each routing direction defined by the ball pads, the '245 Patent ensures that the high stress area is no larger than required to solve the problem of reliably routing signal traces in a high density substrate in which ball pads are disposed in the area around the die corner. (EX2003, ¶127.) If, for example, the high stress

area was defined as a circle large enough to circumscribe the polygon shown in FIGS. 4 and 5, restrictions on signal routing would be imposed in certain areas of the circle outside the polygon that would needlessly reduce signal density without increasing reliability. (EX2003, ¶128.) Conversely, if the high stress area was defined as a circle small enough to fit inside the polygon shown in FIGS. 4 and 5, cracking of signal traces routed outside the circle but within two ball pad pitches of the die corner would occur. (EX2003, ¶129.) Thus, Patent Owner's proposed construction is correct when viewed in the context of the purpose of the invention. (EX2003, ¶130.)

Patent Owner's proposed construction is also supported by the only disclosed embodiment of the '245 Patent, which clearly shows the high stress areas bounded in the horizontal, vertical, and diagonal directions corresponding to signal trace routing directions defined by the ball pads. (*See, e.g.*, EX1001 at FIGS. 4 and 5; *see also* EX1001 at 3:24–8; EX2003, ¶131.)

Additionally, Patent Owner's proposed construction is correct because the '245 Patent disparages the “existing solution” in which a circular shaped area with a one millimeter radius is defined using the die corner as the center and traces are routed around the circular region. (EX1001 at 2:6–15 (“A disadvantage of having a one (1) millimeter radius region under the die corner 38a is that it is not sufficient

to avoid trace cracks in the layer L8 under temperature cycling conditions for all packaging technologies.”); EX2003, ¶132.) In contrast, the size of the high stress area in the ‘245 Patent is based on ball pad pitch and the shape is based on routing directions defined by the ball pads, thereby establishing an area that is no larger than required to eliminate cracking of signal traces and accommodating a range of die sizes. (EX2003, ¶133.)

For at least these reasons, Patent Owner's proposed construction of this limitation to mean “within two ball pad pitches of the corner of the die in each routing direction defined by the ball pads” is submitted to be correct and should be adopted by the Board. (EX2003, ¶134.)

V. ARGUMENT

A. PETITIONER HAS FAILED TO SATISFY ITS BURDEN UNDER 35 U.S.C. § 316(e)

The petitioner in an IPR bears the burden of proving by a preponderance of the evidence that each challenged claim is unpatentable. 35 U.S.C. § 316(e).

Petitioner has failed to meet this burden.

1. Ground 4: Devnani-AAPA Does Not Render Obvious Claims 1, 2, 4, and 5

Ground 4 of the Petition alleges that the combination of Devnani (EX1005) and AAPA (EX1001) (“Devnani-AAPA”) renders claims 1, 2, 4, and 5 obvious. (EX2003, ¶135) However, Petitioner has failed to show by a preponderance of

evidence that Devnani-AAPA renders claims 1, 2, 4, and 5 obvious because, as noted above in Section II.B.1 *supra*, Petitioner has not shown that the purported AAPA is in fact prior art nor has Petitioner shown that Devnani by itself renders claims 1, 2, 4, and 5 obvious. (EX2003, ¶136.) Furthermore, even if the purported AAPA is considered prior art (which it should not be), Petitioner has not shown by a preponderance of evidence that Devnani-AAPA renders claims 1, 2, 4, and 5 obvious. (EX2003, ¶137.)

a) Devnani-AAPA Fails to Render Obvious Claim 1

Claim 1 is directed to a semiconductor package comprising, among other things, an area “wherein none of the signal traces of the bottom routing layer are located over ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die.” (EX1001 at 4:17–20; EX2003, ¶138.) As noted above in Section IV.A, the term “wherein none of the signal traces of the bottom routing layer are located over ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die” should be construed to mean “wherein the plurality of ball pads includes ball pads disposed in an area within two ball pad pitches of the corner of the die and wherein none of the signal traces of the bottom routing layer are located over the ball pads in the area.” (EX2003, ¶138.)

Furthermore, as noted above in Section IV.C, the term “within two ball pad pitches of the corner of the die” in claim 1 should be construed to mean “within two ball pad pitches of the corner of the die in each routing direction defined by the ball pads.” (EX2003, ¶140.)

Devnani-AAPA fails to render obvious claim 1 for at least the following reasons. (EX2003, ¶141.)

(i) The Proposed Devnani-AAPA Combination Lacks Ball Pads Within the Alleged High Stress Area

As noted above, when properly construed, claim 1 requires ball pads to be disposed in an area within two ball pad pitches of the corner of the die. (EX2003, ¶142.) Petitioner identified an alleged high stress zone in the proposed Devnani-AAPA combination, (*see, e.g.*, Pet. at 36–42), but presented no evidence that ball pads are disposed within the alleged high stress zone. (EX2003, ¶143.)

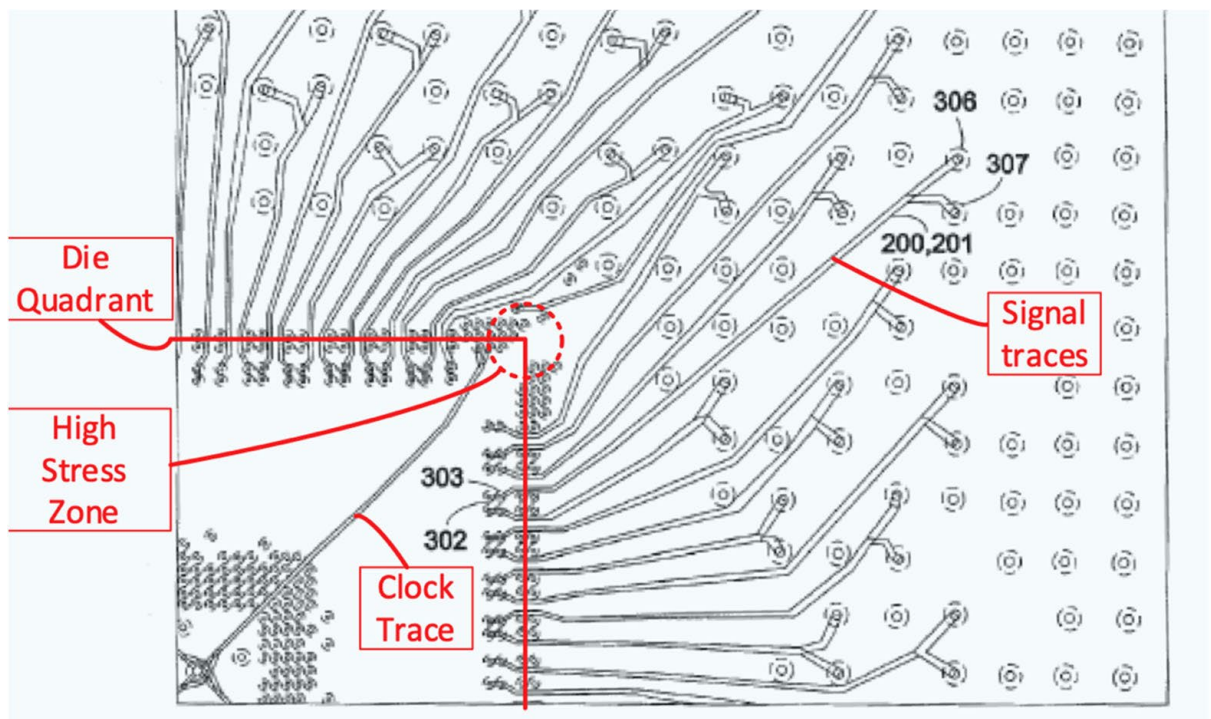
The thrust of Petitioner's argument is that Devnani-AAPA shows all of the signal traces being routed away from a high stress zone associated with the corner of the die; and, with all signal traces being routed away from the high stress zone, the claim limitation “none of the signal traces of the bottom routing layer are located over ball pads of the ball pad layer” is met. (*Id.*; EX2003, ¶144.) Petitioner then goes on to talk about the limitation “two ball pad pitches of the corner of the die”

and how the purported AAPA renders it obvious. (*Id.* at 37–41; EX2003, ¶145.)

What Petitioner doesn't mention is that it deliberately parsed the claim language to leave out the phrase—"which are disposed in an area within"—that connects the former limitation with the latter limitation. (EX2003, ¶146.) As noted above in Section IV.A, when the phrases are read together, the full limitation reads "wherein none of the signal traces of the bottom routing layer are located over ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die." (EX2003, ¶147.) This conveys a much different meaning, as it refers to "ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die," meaning the package *must have ball pads in the defined area*. (EX2003, ¶148.)

The lack of ball pads in the alleged high stress zone in the proposed Devnani-AAPA combination is manifest in annotated Figure 3 of Devnani (reproduced below) that is "annotated to illustrate where a die quadrant resides when the IC die is mounted upon the package 300 and to identify the AAPA high stress zone associated with the corner of the die. . . . signal traces 200 of the bottom routing layer are routed from edges of the die and around an area (e.g., the AAPA high stress zone) associated with the die corner." (Pet. at 36; EX2003, ¶149.) Devnani explains that elements 306, 307 in Figure 3 are vias that connect to solder balls 401 (not

shown). (EX1005 at ¶[0023]; EX2003, ¶150.) Each of the vias is depicted as a circular hole surrounded by a phantom circle. (EX2003, ¶151.) There are numerous vias depicted in Figure 3, but they are all located far away from the die. (EX2003, ¶152.) None of the vias (and, thus, none of the solder balls on the bottom layer) are located below the die, much less in an area within two ball pitches of the die corner. (EX2003, ¶153.)



Devnani Figure 3 (Annotated by Petitioner)

(Pet. at 37 (EX1005, FIG. 3 annotated; (EX2003, ¶153.) No ball pads are highlighted or annotated by Petitioner. (Pet. at 37–42; (EX2003, ¶154.)

In fact, Petitioner's expert admitted that he doesn't know if there are ball pads disposed in the alleged high stress zone identified by Petitioner:

Q. Are there any ball pads under the alleged high-stress zone in the annotated version of Figure 3 of Devnani?

MR. TAYLOR: Objection, form.

A. I - - I don't know. I do know there's no signal traces routed there, and that's what the claim is requiring. So the signal traces be routed away from the high-stress corners.

(EX2004, 49:22–50:8; EX2003, ¶155.)

Since the alleged high stress zone of the proposed Devnani-AAPA combination includes no ball pads, Petitioner has failed to show by a preponderance of evidence that claim 1 is obvious over Devnani-AAPA. (EX2003, ¶156.)

(ii) The Alleged High Stress Zone in the Proposed Devnani-AAPA Combination Is Not an Area Within Two Ball Pad Pitches of the Die Corner in Each Routing Direction Defined by the Ball Pads

As noted above in Section IV.A, when properly construed, claim 1 defines an area of increased stress within two ball pad pitches of the corner of the die in each routing direction defined by the ball pads. (EX2003, ¶157.)

In the '245 patent, the routing directions defined by the ball pads

are horizontal, vertical, and diagonal, and that's why the area of increased stress in the illustrated embodiment of the claimed invention is polygonal in shape. (EX2003, ¶158.)

Petitioner's expert admitted as much during his deposition:

Q: Okay. Would you agree that the shape of the high-stress zone 58 in Figures 4 and 5 [of the '245 Patent] is polygonal?

MR. TAYLOR: Objection, form.

A: Is that maybe -- is that what they call it in the patent and I just don't recall?

Q: I'm asking you if you think it would be fair to characterize the shape that's shown in Figures 4 and 5 as polygonal?

MR. TAYLOR: Objection, form.

A: I don't recall what that word means. Are you talking polygonal?

Q: Yeah.

A Oh. Yeah. I think so.

(EX2004, 78:10–79:1; EX2003, ¶158.)

Petitioner's expert also admitted that the shape of the high stress zone in Figures 4 and 5 of the '245 Patent is different than the circularly shaped high

stress zones of the alleged AAPA and the proposed Devnani-AAPA combination:

Q. But you agree that the high-stress zone 58 in Figures 4 and 5 of the '245 patent is not a circular shape?

A. What they've labeled there for 58 and 60 are not circles, no.

(EX2004, 81:4–8; EX2003, ¶158.)

Even so, Petitioner fails to explain why the shape of the high stress area in the illustrated embodiment of the '245 Patent differs from the circular high stress area in the alleged AAPA, much less provide a claim construction analysis proving that the two ball pad limitation covers a circularly shaped high stress area like the alleged AAPA or the proposed Devnani-AAPA combination. (EX2003, ¶159.) Petitioner simply alleges in a conclusory manner that claim 1 does not require a particular shape of a high stress zone. (Pet. at 40–41; EX2003, ¶160.) As explained above, this is not true. (EX2003, ¶161.) Claim 1 defines an area within two ball pad pitches of the corner of the die, which when read in light of the specification would be understood by a POSITA to mean two ball pad pitches in each routing direction defined by the ball pads. (EX2003, ¶162.) No evidence has been presented that the routing directions defined by the ball pads of the alleged AAPA or Devnani would constitute a circle. (EX2003, ¶163.) In fact, the circular shape of the alleged AAPA is disavowed by the '245 Patent and none of the illustrated embodiments of the '245

patent show a circular high stress area. (EX1001 at 1:11–15 (“A disadvantage of having a one (1) millimeter radius region under the die corner 38a is that it is not sufficient to avoid trace cracks in the layer L8 under temperature cycling conditions for all packaging technologies.”) 3:22–30 (“Each high stress zone 58, 60 is similarly shaped . . . ”, FIG. 4, FIG. 5; EX2003, ¶164.) For these additional reasons, Petitioner has failed to show by a preponderance of evidence that claim 1 is obvious over Devnani-AAPA. (EX2003, ¶165.)

**(iii) It Would Not Have Been Obvious For the
Alleged High Stress Zone in the Proposed
Devnani-AAPA Combination To Have a Radius
of Two Ball Pad Pitches**

Even if the Board rejects Patent Owner's proposed constructions relating to the term “wherein none of the signal traces in the bottom routing layer are located over ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die,” Petitioner has not proven by a preponderance of evidence that it would have been obvious to define a high stress zone in the proposed Devnani-AAPA combination within two ball pad pitches of the corner of the die. (EX2003, ¶166.) Petitioner concedes that Devnani does not explicitly define an area of high stress within “two ball pad pitches of the corner of the die,” as claimed. (Pet. at 37; EX2003, ¶167.) For this element, Petitioner relies exclusively on AAPA. (*Id.*; EX2003, ¶168.)

However, a consequence of there being no ball pads under the corner of Devnani is that, even if the purported AAPA is prior art (which it is not), there would have been no reason for a POSITA to look to the purported AAPA for a solution. (EX2003, ¶169.) That is, since Devnani Figure 3 does not have ball pads of the ball pad layer disposed in the area surrounding the die corner where they can cause cracking, there would be no reason to look to the purported AAPA for a solution because the problem the alleged AAPA is purported to solve is ball pads causing cracking. (EX2003, ¶170.) In particular, there is no basis for Petitioner's addition of a high stress zone defined by a one millimeter circle centered on the corner of the die in Devnani Figure 3. (EX2003, ¶171.)

As explained above in Section IV.A, the two ball pad pitch implementation of claim 1 differs from the fixed one (1) millimeter radius in that, among other things, the two ball pad pitch implementation is not fixed in size and can therefore accommodate a variety of dies and ball pad pitch sizes. (EX2003, ¶172.) Even though Petitioner mischaracterizes the two ball pad pitch implementation as merely being a larger version of the 1 mm solution, the actual size depends on the ball pad pitch of the package. (EX2003, ¶173.)

As the '245 Patent explains, the two ball pad pitch implementation depends on the size of the die and how the ball pads are dispersed. ('245 Patent at 2:36–39;

3:10–30; FIG. 4; EX2003, ¶174.) Petitioner fails to account for this key fact. (EX2003, ¶175.) The two ball pad pitch implementation of claim 1 (as opposed to hard-coding a 1 mm circle) is critical to the invention to “reduce cracks in the signal traces and therefore avoids functional failures caused by stresses under the die corner.” (’245 Patent at 2:16–18; EX2003, ¶176.) Contrary to Petitioner’s assertions, the size or shape of the high stress zone is clearly defined by the language of claim 1 and in view of the ’245 Patent’s specification. (’245 Patent at 4:10–20, 2:36–39, 3:10–30, FIGS. 4, 5; EX2003, ¶177.)

Petitioner also presents contradictory obviousness arguments. (EX2003, ¶178.) For example, Petitioner contradicts itself within the same paragraph by stating in one sentence that “a POSITA would naturally select [] *any size or shaped area* they believe would result in reducing failures due to trace cracks[]” and in the next sentence stating that “a POSITA would have anticipated success in reducing the number of stress cracks in signal traces by routing signal traces around a *larger area than 1 mm* from the corner of the die . . . ” (Pet. at 41; EX2003, ¶179.) Petitioner’s obviousness ground on claim 1 cannot stand on such contradictory positions where on one hand the high stress zone can be anything a POSITA believes is correct and on the other hand, it must be an area larger than 1 mm. (EX2003, ¶180.)

Nor is this a case of “shape modifications without clear significance,” as alleged by Petitioner. (Pet. at 42.) In *In re Dailey*, 357 F.2d 669 (C.C.P.A. 1966), the case cited by Petitioner, there was no evidence that the particular configuration of the claimed disposable plastic nursing container was significant. Here, the configuration of the claimed “area within two ball pad pitches of the corner of the die” is significant because it reduces cracks in the signal traces and avoids functional failures caused by stresses under the die corner for all packaging technologies. (’245 Patent at 2:16–19, 37–39; EX2003, ¶181.) The one-size-fits-all approach of the 1 mm radius does not. (’245 Patent at 2:12–15; EX2003, ¶182.) Thus, *In re Dailey* does not provide a basis to find claim 1 obvious.

Furthermore, there is no evidence that the high stress zone drawn by Petitioner in annotated FIG. 3 of Devnani-AAPA has a radius of two ball pad pitches. (EX2003, ¶183.) In fact, Petitioner’s expert admits that he doesn’t know the size of the alleged high stress zone Petitioner identified in Devnani-AAPA Figure 3:

Q. So how large is the high-stress zone in the annotated version of Figure 3 of Devnani?

MR. TAYLOR: Objection, form.

A. I mean, it would be whatever size it needs to be. I was just highlighting the corner of the chip, or the die, to show that’s where the high-stress region was. It would depend on the size of the die, the thickness of the die. It’s - - the ***whole point of the circle was just to show the corner of the die***, which is where the claim requires or defines

the high - - increased area of high stress or area of increased stress. And so, I mean, I could shrink it, and I don't think it would change my opinion. It's just I wanted to show the signals were routed away from that corner.

(EX2004, 45:2–18; EX2003, ¶184.)

Petitioner argues that a POSITA would have been motivated to use a larger area based on the discussion in the '245 Patent about the disadvantages of the purported AAPA solution. (Pet. at 27–28; EX2003, ¶185.) According to Petitioner, such larger area “would include an area defined by 2 ball pad pitches from the corner of the die.” (Pet. at 28; EX2003, ¶186.) There are at least two major problems with these arguments. (EX2003, ¶187.)

First, Petitioner has not shown that the disadvantages of the purported AAPA solution were known in the prior art. (EX2003, ¶188.) In full, the '245 Patent merely states “[a] disadvantage of having a one (1) millimeter radius region under the die corner 38a is that it is not sufficient to avoid trace cracks in the layer L8 under temperature cycling conditions for all packaging technologies.” (EX1001 at 1:11–15; EX2003, ¶189.) The '245 Patent does not say the disadvantage was known in the prior art, or common knowledge, or otherwise, and there is absolutely no analysis in the Petition showing that the disadvantages were known in the prior art. EX2003, ¶190.) It's simply assumed by Petitioner. Therefore, it's improper for Petitioner to rely on the stated disadvantage for motivation to modify the purported AAPA

solution. (EX2003, ¶191; *see, e.g., Forest Laboratories, LLC v. Sigmapharm Laboratories, LLC*, 918 F.3d 928 (Fed. Cir. 2019) (“We have recognized that where a problem was not known in the art, the solution to that problem may not be obvious, because 'ordinary artisans would not have thought to try at all because they would not have recognized the problem.’”) *citing Leo Pharm Prods Ltd v. Rea*, 726 F.3d 1346, 1357 (Fed. Cir. 2013). At deposition, Petitioner's expert was evasive on whether he agreed with the Board that there is no disclosure in the '245 Patent that the disadvantages associated with the existing solutions were known in the art:

Q: So do you disagree or agree with the statement in the Institution Decision on page 20 at lines 6 through 13?

MR. TAYLOR: Objection, form.

A: I don't -- I don't disagree with what the APJs had written there, but I don't necessarily agree.

(EX2004, 20:8–14; EX2003, ¶192.)

Second, even if the disadvantage was known in the prior art (which Petitioner has not even tried to show), there's simply no support for Petitioner's argument that “an area larger than 1 mm from the corner of the die . . . would include an area defined by 2 ball pad pitches from the corner of the die.” EX2003, ¶193.) This is nothing more than hindsight analysis. Petitioner has not proffered any evidence to support the notion that any high stress zone larger than the purported AAPA solution

would encompass the “two ball pad pitches” limitation. (EX2003, ¶194.)

Third, with regard to Petitioner's allegation that “there is no specific disclosure regarding any advantages, criticality, or unexpected results related to [the “two ball pitch” limitation],” this is provably false. (EX2003, ¶195.) In fact, the '245 Inventors stated that the purported AAPA solution is “not sufficient to avoid trace cracks . . . under temperature cycling conditions for all packaging technologies,” (EX1001 at 2:11–15), that “an improved package is needed,” (*id.* at 2:16–18), and that “[t]he present invention provides such a package,” (*id.* at 2:19). (EX2003, ¶196.) In other words, the inventors believed that, unlike the purported AAPA solution, the claimed invention was sufficient to avoid trace cracks under temperature cycling conditions *for all packaging technologies*. (EX2003, ¶197.) This is certainly an advantage and a significant improvement over the purported AAPA solution. (EX2003, ¶198.) A POSITA reading the '245 Patent would also understand that the “two ball pad pitch” limitation is advantageous and significant in that it provides an adjustable solution suitable “for all packaging technologies” (e.g., the “area of increased stress” adjusts to accommodate packages having ball grids with different ball pitches) as opposed to a one-size-fits-all fixed radius area like the purported AAPA solution. (EX2003, ¶199.) The invention of claim 1 is thus distinguishable from the cases cited by Petitioner relating to simple changes in

size/proportion and shape.¹ (*See* Pet. at 8–9; EX2003, ¶200.)

In the first case cited by Petitioner, *In re Rose*, 220 F.2d 459 (C.C.P.A. 1955), the Court held a claim to a lumber package unpatentable because the only difference between the claimed invention and the prior art was a change in the size of the article in question. Here, claim 8 does not recite a change in the size of the semiconductor package, and the “two ball pad pitch” limitation of claim 8 differs from the fixed one (1) millimeter radius in that it is not fixed in size and can therefore accommodate a variety of ball pad pitch sizes. (EX2003, ¶201.)

The claim in *In re Rinehart*, 531 F.2d 1048 (C.C.P.A. 1976), involved “mere scaling up of a prior art process capable of being scaled up.” Here, the size of the zone in the alleged prior art was fixed regardless of the size of the die (i.e., not scalable). (EX2003, ¶202.)

The only difference between the claims and the prior art in *Gardner v. TEC Syst., Inc.*, 725 F.2d 1338 (Fed. Cir. 1984), *cert. denied*, 469 U.S. 830 (1984) was a

¹ Although Petitioner did not cite these cases against claim 8, the arguments presented in this section distinguishing the invention of claim 1 from these cases apply equally with respect the invention of claim 8, which also recites the “two ball pad pitches” limitation.

recitation of relative dimensions of the claimed device that did not cause the device to perform differently than the prior art device. Here, the claimed package performs differently from the alleged prior art in being less prone to cracking and more reliable “for all packaging technologies” due to the adjustability of the “two ball pad pitches” limitation. (EX2003, ¶203.)

Finally, as mentioned above, in *In re Dailey*, 357 F.2d 669 (C.C.P.A. 1966), there was no evidence that the particular configuration of the claimed disposable plastic nursing container was significant. Here, the configuration of the claimed package is significant because it is less prone to cracking than alleged prior art packages and is more reliable “for all packaging technologies” due to the adjustability of the “two ball pad pitches” limitation. (EX2003, ¶204.)

It should also be noted that, in contrast to Patent Owner, Petitioner did not analyze claim 1 under any of the above cases with any degree of particularity. Since Petitioner has failed to show by a preponderance of evidence that it would have been obvious to define a high stress area within two ball pad pitches of the die corner in the proposed Devnani-AAPA combination, the Board should find claim 1 patentable over the proposed combination. (EX2003, ¶205.)

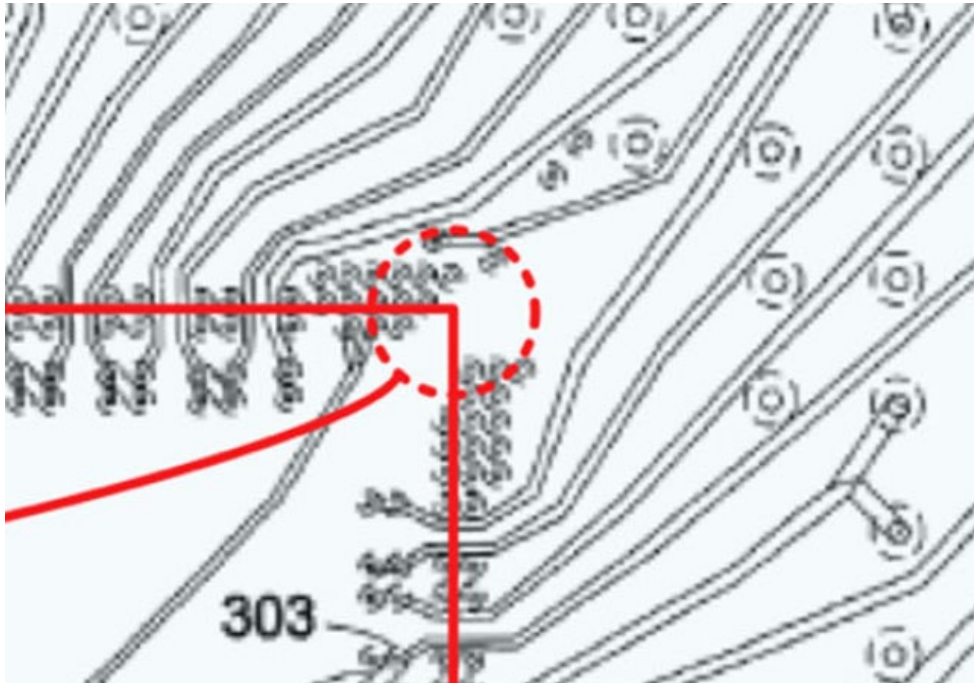
b) Ground 4 Fails to Render Obvious Claim 2

Dependent claim 2 recites a package as recited in claim 1, wherein:

none of the signal traces of the bottom routing layer are located within two ball pad pitches of the corner of the die.

(EX1001 at 4:21–23; EX2003, ¶206.)

A dependent claim contains all of the limitations of the claim or claims from which it depends. (EX2003, ¶207.) Therefore, claim 2 distinguishes over Devnani-AAPA for at least the same reasons discussed above with regard to claim 1. (EX2003, ¶208.) Nor has Petitioner shown that the combination of Devnani-AAPA would exhibit a complete lack of signal traces in the area located within two ball pad pitches of the corner of the die. (EX2003, ¶209.) On the contrary, even in Petitioner's annotated version of Figure 3 of Devnani reproduced below, the alleged high stress zone encompasses a signal trace (near an upper portion of the circle) and therefore does not meet the claim limitation "wherein none of the signal traces of the bottom routing layer are located within two ball pad pitches of the corner of the die." (EX2003, ¶210.)



(Pet. at 22 (Annotation by Petitioner) (enlarged).)

This is not surprising since Petitioner's expert admitted that he does not even know where the ball pads are located in Devnani. (EX2003, ¶210.)

Q. Are there any ball pads under the alleged high-stress zone in the annotated version of Figure 3 of Devnani?

MR. TAYLOR: Objection, form.

A. I - - I don't know. I do know there's no signal traces routed there, and that's what the claim is requiring. So the signal traces be routed away from the high-stress corners.

(EX2004, 49:22–50:8; EX2003, ¶210.)

Claim 2 is therefore submitted to be patentable over Devnani-AAPA for this additional reason. (EX2003, ¶211.)

c) Ground 4 Fails to Render Obvious Claim 4

Dependent claim 4 recites a package as recited in claim 1, wherein:

the package comprises nine layers with the routing layer being the eighth layer and the ball pad layer being the ninth layer, on a bottom of the package.

(EX1001 at 4:28–31; EX2003, ¶212.)

A dependent claim contains all of the limitations of the claim or claims from which it depends. (EX2003, ¶213.) Therefore, claim 4 distinguishes over Devnani-AAPA for at least the same reasons discussed above with regard to claim 1. (EX2003, ¶214.) Moreover, Devnani does not disclose a package with the routing layer being the eighth layer and the ball pad layer being the ninth layer. (EX2003, ¶215.) Aside from a conclusory statement that “[a] POSITA would have been motivated to combine the AAPA 9-layer stackup 20 with the package 30 of Devnani to route signals, power, and ground between a die and PCB,” (Pet. at 43-44), Petitioner has not shown that it would be obvious to modify Devnani to include these additional limitations of claim 4. (EX2003, ¶216.) Thus, claim 4 is patentable over Devnani-AAPA for this additional reason.

d) Ground 4 Fails to Render Obvious Claim 5

Dependent claim 5 recites a package as recited in claim 1, wherein:

the die is mounted to the top layer in an arrangement other

than a pin connection.

(EX1001 at 4:32–34; EX2003, ¶217.)

A dependent claim contains all of the limitations of the claim or claims from which it depends. (EX2003, ¶218.) Therefore, claim 5 distinguishes over Devnani-AAPA for at least the same reasons discussed above with regard to claim 1. (EX2003, ¶ 219.)

2. Ground 1 Fails to Render Obvious Claim 8 Over Devnani-AAPA

Claims 7, 10, and 11 have been statutorily disclaimed. (EX2002.)

With regard to claim 8, Petitioner has failed to show by a preponderance of evidence that Devnani-AAPA renders obvious claim 8 because, as noted above in Section II.B.1 *supra*, Petitioner has not shown that the purported AAPA is in fact prior art nor has Petitioner shown that the differences between Devnani and claim 8 would have been obvious. (EX2003, ¶2020.) Furthermore, even if the purported AAPA is considered prior art (which it should not be), Petitioner has not shown that claim 8 would have been obvious over the proposed Devnani-AAPA combination. (EX2003, ¶221.)

Claim 7, from which claim 8 depends, recites a semiconductor package comprising the following limitations:

a top layer having a die mounted thereon, *said die having a corner defining a surrounding area of increased stress;*

and

a plurality of layers under the top layer, said plurality of layers comprising a bottom routing layer having signal traces thereon, and ball pad layer under the bottom routing layer, said ball pad layer having a plurality of ball pads dispersed thereon, ***wherein none of the signal traces of the bottom routing layer are located within the area of increased stress defined by the corner of the die.***

(EX1001 at 4:38–48 (emphasis added); EX2003, ¶222.)

Claim 8 further recites:

wherein none of the signal traces of the bottom routing layer are located within two ball pad pitches of the corner of the die.

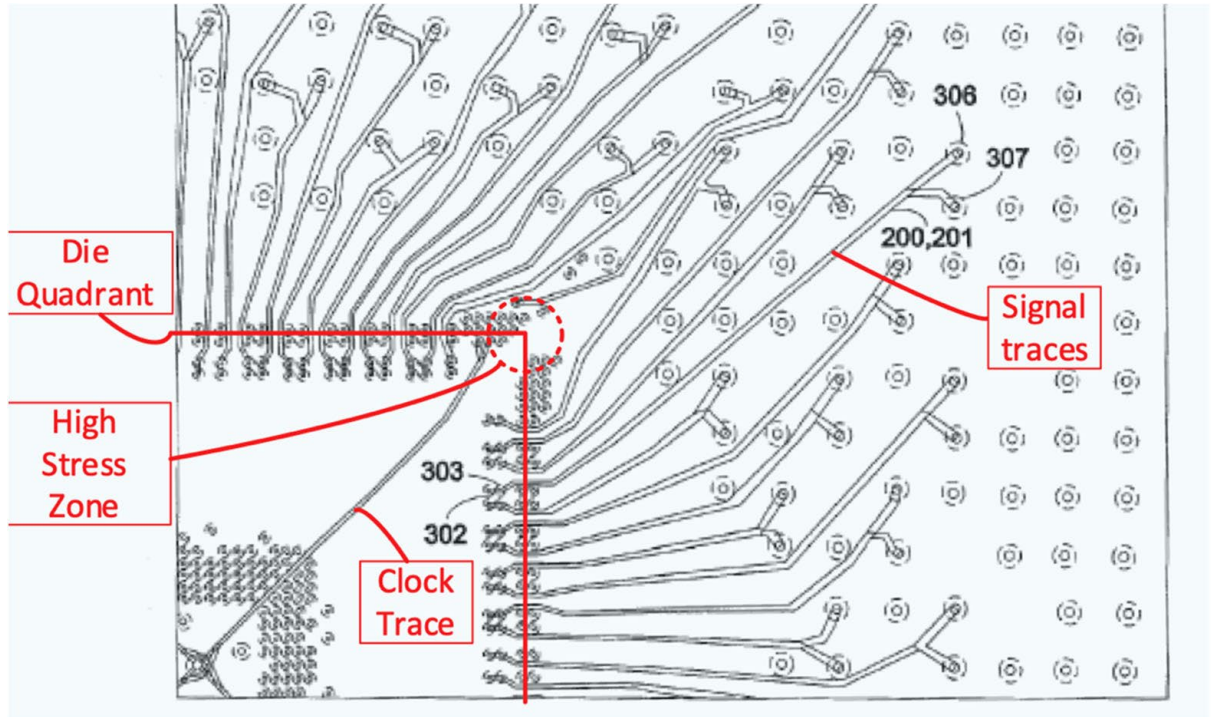
(EX1001 at 4:49–51 (emphasis added); EX2003, ¶223.)

With regard to the claimed “area of increased stress,” the ’245 Patent explains that “[a]reas of high stress are associated with the die corner . . . and in particular ***the ball pads which are positioned under the area surrounding the die corner . . .***.” (EX1001 at 1:58–60 (emphasis added); *see also id.* at 3:6–9, 28–30, and 45–50; EX2003, ¶224.) The edges of the ball pads on the bottom-most layer under the area surrounding the die corner act as stress concentration points that, under temperature cycling conditions, may initiate cracks that can extend upward through the dielectric layer and damage signal traces on the bottom routing layer above the ball pads. (*Id.* at 1:61–2:2; EX2003, ¶225.) The invention of claim 8 solves this problem by routing

signal traces such that “none of the signal traces of the bottom routing layer are located within two ball pad pitches of the corner of the die.” (*Id.* at 4:49–51; EX2003, ¶226.)

Even if the purported AAPA is considered prior art, the invention of claim 8 would not be obvious over Devnani in view of AAPA for at least the following reasons. (EX2003, ¶227.)

Petitioner relies heavily on an annotated version of Figure 3 of Devnani-AAPA (reproduced below) to attack claim 8. (EX2003, ¶228.) While Petitioner admits that Devnani does not *explicitly* state that the die corner in the figure defines a surrounding area of increased stress, it is argued that there is implicitly an area of increased stress near the die corner due to different thermal expansion characteristics. (Pet. at 18; EX2003, ¶229.) As illustrated below, Petitioner annotated Figure 3 to show an alleged high stress zone of circular shape centered on the die corner. (*Id.*; EX2003, ¶230.)



Petitioner argues that Devnani-AAPA Figure 3 shows all of the signal traces routed outside the alleged high stress zone. (Pet. at 22; EX2003, ¶231.) As backup, Petitioner argues that a POSITA implementing the semiconductor package of Devnani would look to the purported AAPA to route signal traces away from the alleged high stress zone in Figure 3. (*Id.*; EX2003, ¶232.)

What Petitioner doesn't say about Figure 3 of Devnani is important—there are no ball pads on the bottom layer below the alleged area of increased stress surrounding the corner of the die. (EX2003, ¶233.) Devnani explains that elements 306, 307 in Figure 3 are vias that connect to solder balls 401 (not shown). (EX1005 at ¶[0023]; EX2003, ¶234.) Each of the vias is depicted as a circular hole surrounded

by a phantom circle. (EX2003, ¶235.) There are numerous vias depicted in Figure 3, but they are all located far away from the die. (EX2003, ¶236.) None of the vias (and, thus, none of the solder balls on the bottom layer) in Petitioner's annotated Figure 3 are located below the alleged area of increased stress surrounding the die corner. (EX2003, ¶236.) As explained above in Section IV.B, when properly construed, the claimed "area of increased stress" in claim 8 is associated with ball pads below an area surrounding the die corner—not just thermal cycling. (EX2003, ¶238.) The ball pads act as "stress concentration points." (EX1001 at 1:61–65; EX2003, ¶239.) Because there are no ball pads around the corner acting as stress concentration points, Devnani does not have "a corner defining a surrounding area of increased stress" as claimed. (EX2003, ¶240.)

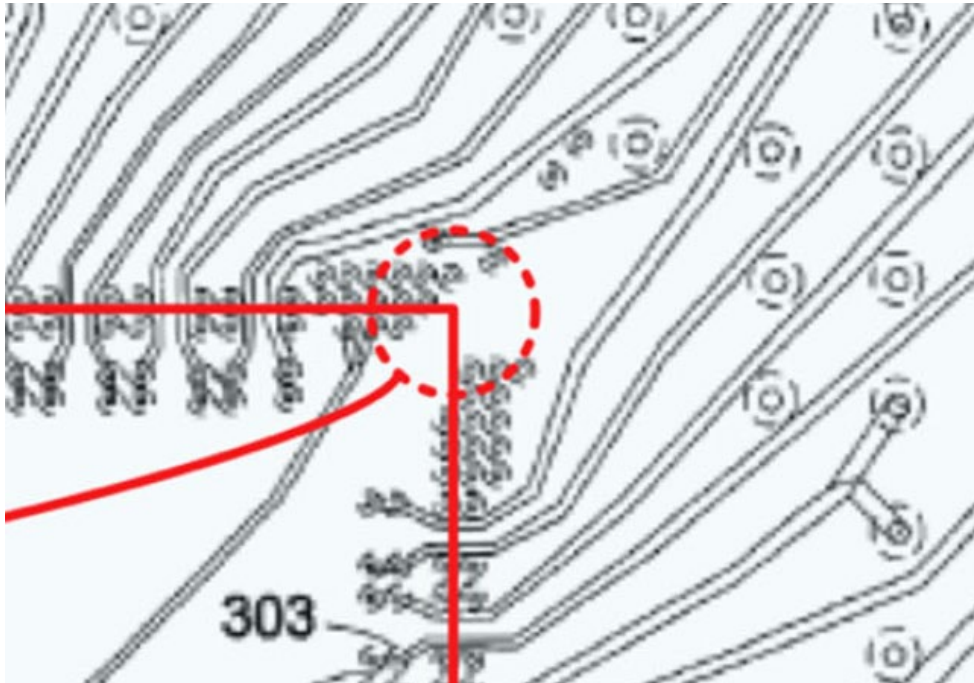
The consequences of this omission by Petitioner are two-fold. (EX2003, ¶241.) First, since Devnani does not have "a corner defining a surrounding area of increased stress" as claimed, there would be no reason to look to the purported AAPA for a solution to a non-existent problem. (EX2003, ¶242.)

Second, even if Devnani is considered to have a corner defining a surrounding area of increased stress due solely to different thermal characteristics between the die and substrate, Petitioner has not shown that a POSITA would look to the purported AAPA for a solution, since the purported AAPA is focused on a different

problem due to ball pads under an area surrounding the corner causing cracking, and there are no ball pads within Petitioner's alleged high stress zone around the die corner in Devnani. (EX2003, ¶243.) In particular, there is no basis for Petitioner's addition of a high stress zone defined by a one millimeter circle centered on the corner of the die in Figure 3 of Devnani. (EX2003, ¶244.) Why would one millimeter be appropriate if there are no ball pads under Devnani's die corner?

Furthermore, as explained previously in Section IV.C, the term "within two ball pad pitches of the corner of the die" in claim 8 should be construed to mean "within two ball pad pitches of the corner of the die in each routing direction defined by the ball pads." (EX1001 at 4:46–51; EX2003, ¶245.) No evidence has been presented that two ball pad pitches in each routing direction defined by the ball pads of the alleged AAPA or Devnani would result in a circular region as proposed by Petitioner. (EX2003, ¶246.)

Finally, it should be noted that, even in Petitioner's annotated version of Figure 3 of Devnani reproduced below, the alleged circular high stress zone encompasses a signal trace (near an upper portion of the circle) and therefore does not meet the claim limitation "wherein none of the signal traces of the bottom routing layer are located within the area of increased stress defined by the corner of the die." (EX2003, ¶247.)



(Pet. at 22 (Annotation by Petitioner) (enlarged).)

Even if the Board rejects Patent Owner's proposed constructions relevant to claim 8, Petitioner has not proven that it would have been obvious to define the surrounding area of increased stress in the proposed Devnani-AAPA combination as an area within two ball pad pitches of the corner of the die. (EX2003, ¶248.) Petitioner concedes that Devnani does not explicitly define an area of high stress within "two ball pad pitches of the corner of the die," as claimed. (Pet. at 27; (EX2003, ¶249.) For this element, Petitioner relies exclusively on AAPA. (*Id.*; EX2003, ¶250.)

However, a consequence of there being no ball pads under the corner of Devnani is that, even if the purported AAPA is considered prior art (which it should

not be), there would have been no reason to look to the purported AAPA for a solution. (EX2003, ¶251.) That is, since Devnani Figure 3 does not have ball pads of the ball pad layer disposed in the area surrounding the die corner where they can cause cracking, there would be no reason to look to the purported AAPA for a solution because the problem the alleged AAPA is purported to solve is ball pads causing cracking. (EX2003, ¶252.)

Petitioner argues that a POSITA would have been motivated to use a larger area based on the discussion in the '245 Patent about the disadvantages of the purported AAPA solution. (Pet. at 27–28; EX2003, ¶253.) According to Petitioner, such larger area “would include an area defined by 2 ball pad pitches from the corner of the die.” (Pet. at 28; EX2003, ¶254.) There are at least three major problems with these arguments. (EX2003, ¶255.)

First, Petitioner has not shown that the disadvantages of the purported AAPA solution were known in the prior art. (EX2003, ¶256.) In full, the '245 Patent merely states “[a] disadvantage of having a one (1) millimeter radius region under the die corner 38a is that it is not sufficient to avoid trace cracks in the layer L8 under temperature cycling conditions for all packaging technologies.” (EX1001 at 1:11–15; EX2003, ¶257.) The '245 Patent does not say the disadvantage was known in the prior art, or common knowledge, or otherwise, and there is absolutely no analysis

in the Petition showing that the disadvantages were known in the prior art. (EX2003, ¶258.) It's simply assumed by Petitioner. Therefore, it's improper for Petitioner to rely on the stated disadvantage for motivation to modify the purported AAPA solution. (EX2003, ¶259; *see, e.g., Forest Laboratories, LLC v. Sigmapharm Laboratories, LLC*, 918 F.3d 928 (Fed. Cir. 2019) (“We have recognized that where a problem was not known in the art, the solution to that problem may not be obvious, because 'ordinary artisans would not have thought to try at all because they would not have recognized the problem.’”) *citing Leo Pharm Prods Ltd v. Rea*, 726 F.3d 1346, 1357 (Fed. Cir. 2013). At deposition, Petitioner's expert was evasive on whether he agreed with the Board that the '245 Patent does not characterize the disadvantages associated with the existing solutions as known in the art:

Q: So do you disagree or agree with the statement in the Institution Decision on page 20 at lines 6 through 13?

MR. TAYLOR: Objection, form.

A: I don't -- I don't disagree with what the APJs had written there, but I don't necessarily agree.

(EX2004, 20:8–14; EX2003, ¶260.)

Second, even if the disadvantage was known in the prior art (which Petitioner has not even tried to show), there's no support for Petitioner's argument that “an area larger than 1 mm from the corner of the die . . . would include an area defined

by 2 ball pad pitches from the corner of the die.” (Pet. at 28; EX2003, ¶261.) This is nothing more than hindsight analysis. Petitioner has not proffered any evidence to support the notion that any high stress zone larger than the purported AAPA solution would encompass the “two ball pad pitches” limitation. (EX2003, ¶262.)

Third, with regard to Petitioner's allegation that “there is no specific disclosure regarding any advantages, criticality, or unexpected results related to [the “two ball pitch” limitation],” (Pet. at 28), this allegation is provably false. (EX2003, ¶263.) In fact, the '245 Inventors stated that the purported AAPA solution is “not sufficient to avoid trace cracks . . . under temperature cycling conditions for all packaging technologies,” (EX1001 at 2:11–15), that “an improved package is needed,” (*id.* at 2:16–18), and that “[t]he present invention provides such a package,” (*id.* at 2:19). (EX2003, ¶264.) Thus, the inventors believed that, unlike the purported AAPA solution, the claimed invention was sufficient to avoid trace cracks under temperature cycling conditions *for all packaging technologies*. (EX2003, ¶265.) This is certainly an advantage and a significant improvement over the purported AAPA solution. (EX2003, ¶266.) A POSITA reading the '245 Patent would also understand that the “two ball pad pitch” limitation is advantageous and significant in that it provides an adjustable solution suitable “for all packaging technologies” (e.g., the “area of increased stress” adjusts to accommodate packages having ball

grids with different ball pitches) as opposed to a one-size-fits-all fixed radius area like the purported AAPA solution. (EX2003, ¶267.)

Furthermore, there is no evidence that the high stress zone drawn by Petitioner in annotated FIG. 3 of Devnani-AAPA has a radius of two ball pad pitches. (EX2003, ¶268.) In fact, Petitioner's expert admits that he doesn't know the size of the alleged high stress zone Petitioner identified in Devnani-AAPA Figure 3:

Q. So how large is the high-stress zone in the annotated version of Figure 3 of Devnani?

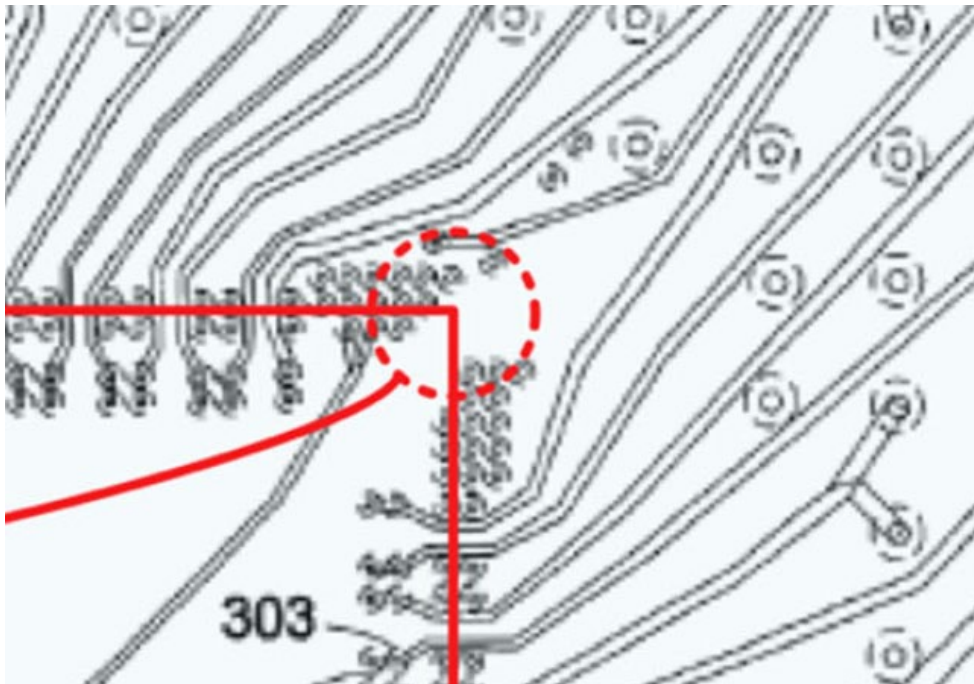
MR. TAYLOR: Objection, form.

A. I mean, it would be whatever size it needs to be. I was just highlighting the corner of the chip, or the die, to show that's where the high-stress region was. It would depend on the size of the die, the thickness of the die. It's - - the *whole point of the circle was just to show the corner of the die*, which is where the claim requires or defines the high - - increased area of high stress or area of increased stress. And so, I mean, I could shrink it, and I don't think it would change my opinion. It's just I wanted to show the signals were routed away from that corner.

(EX2004, 45:2–18; EX2003, ¶269.)

Indeed, even in Petitioner's annotated version of Figure 3 of Devnani reproduced below, the alleged high stress zone "as disclosed by AAPA" (Pet. at 22) encompasses a signal trace (near an upper portion of the circle) and therefore does not meet the claim limitation "wherein none of the signal traces of the bottom routing layer are located within the area of increased stress defined by the corner of the die."

(EX2003, ¶270.) If the alleged high stress zone in Petitioner's annotated version of Figure 3 was made to have a radius larger than 1mm, it could encompass additional signal traces, thereby further distancing Devnani-AAPA from claim 8. (EX2003, ¶271.)



(Pet. at 22 (Annotation by Petitioner) (enlarged)).

3. Ground 5 Fails to Render Obvious Claim 3 Over Devnani-AAPA-Pillai

Dependent claim 3 recites a package as recited in claim 1, wherein:

said ball pad layer has a plurality of ball pads dispersed thereon and no metal traces on the ball pad layer which are connected to the ball pads.

(EX1001 at 4:24-27; EX2003, ¶ 272.)

Claim 3 depends from and, therefore, contains all of the limitations of claim 1. (EX2003, ¶273.) Since Ground 5 does not rely on Pillai to overcome the deficiencies of Devnani-AAPA noted above in Ground 4 with respect to claim 1, claim 3 distinguishes over Devnani-AAPA-Pillai for at least the same reasons noted above in the discussion of claim 1 with regard to Ground 4. (EX2003, ¶275.) Indeed, there is no analysis of Pillai in any respect in Ground 5—only impermissible referencing to a different section of the Petition and the Baker Declaration. (Pet. at 45; EX2003, ¶276.) In any event, Devnani, AAPA, and Pillai are all silent regarding whether on the bond pad layer are connected bond pads. (EX2003, ¶277.) The vias in Pillai are for connecting the ball pads to other layers of the package. (EX2003, ¶278.) The partial cross-section in FIG. 1 of Pillai, by itself, is insufficient to prove that Pillai lacks metal traces connected to bond pads anywhere else on the bond pad layer or to provide motivation to forego metal traces on the bond pad layer. (EX2003, ¶279.) Claim 3 is submitted to be patentable for this additional reason. (EX2003, ¶280.)

4. Ground 6 Fails to Render Obvious Claim 6 Over Devnani-AAPA-Tanahashi

Dependent claim 6 recites a package as recited in claim 1, wherein:

the signal traces on the bottom routing layer comprise at least one voltage bus bar.

(EX1001 at 4:35–37; EX2003, ¶281.)

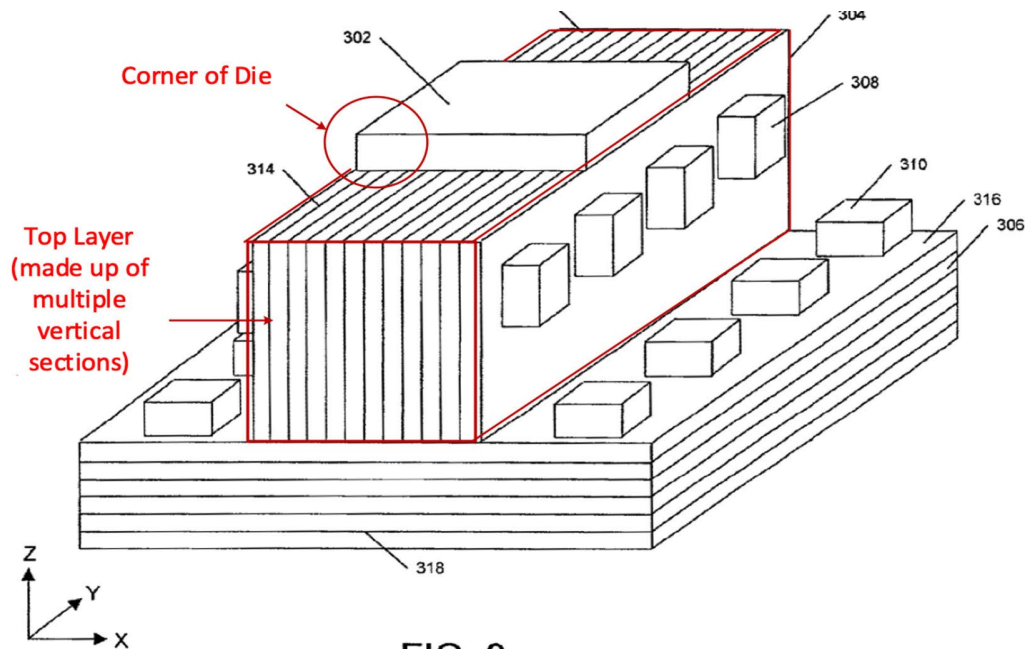
Claim 6 depends from and, therefore, contains all the limitations of claim 1. (EX2003, ¶282.) Since Petitioner relies on Tanahashi for allegedly disclosing the additional limitations of claim 6, not for overcoming the deficiencies of Devnani-AAPA with respect to claim 1, claim 6 distinguishes over Devnani-AAPA-Tanahashi for at least the same reasons discussed above with regard to claim 1. (EX2003, ¶283-285.) Claim 6 is further submitted to be patentable for the additional limitations it recites because Petitioner's annotations of Figure 3B of Tanahashi, by themselves, are insufficient to prove that the power wiring conductor P1 in FIG. 3C of Tanahashi is a voltage bus bar on the bottom routing layer. (EX2003, ¶286.)

5. Ground 7: Chung-Celeron Does Not Render Obvious Claims 1, 2, and 5

Claim 1 recites, among other things, that “none of the signal traces of the bottom routing layer are located over ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die.” (EX1001 at 4:17–20; EX2003, ¶287.) As explained previously in Section IV.A, the proper construction of this claim term requires ball pads to be disposed in an area within two ball pad pitches of the corner of the die. (EX2003, ¶288.)

Petitioner alleges that claim 1 would have been obvious over Chung in view of Celeron (“Chung-Celeron”). (EX2003, ¶289.) Without citing any evidence

regarding the purpose of the clear area in Celeron, Petitioner alleges that a POSITA would have been motivated to combine the multiple routing layers of Chung with the clear area of Celeron to prevent damage to signal traces of the bottom routing layer during thermal cycling. (Pet. at 52; EX2003, ¶290.) Patent Owner disagrees. First, as shown in FIG. 3 of Chung (reproduced below with Petitioner's annotations), the electrical assembly of Chung includes an integrated circuit 302 (IC) mounted on a top surface 312 of a vertical section 304 that includes "multiple conductive layers arranged in parallel with a vertical plane." (EX1006 at [0026]; EX2003, ¶291.) The vertical section is arranged on top of a horizontal section 306 that includes "conductive layers arranged in parallel with a horizontal plane." (EX1006 at [0026]; EX2003, ¶292.) Thus, the conductive layers of the vertical section are arranged perpendicular to the conductive layers of the horizontal section. (EX2003, ¶293.)



(EX1006, Fig. 3 annotated.)

During his deposition, Petitioner's expert agreed that the layers of the vertical section in Chung are perpendicular to the layers of the horizontal section:

Q: And the layers of the vertical package section in Chung are oriented perpendicular to the horizontal package section, correct?

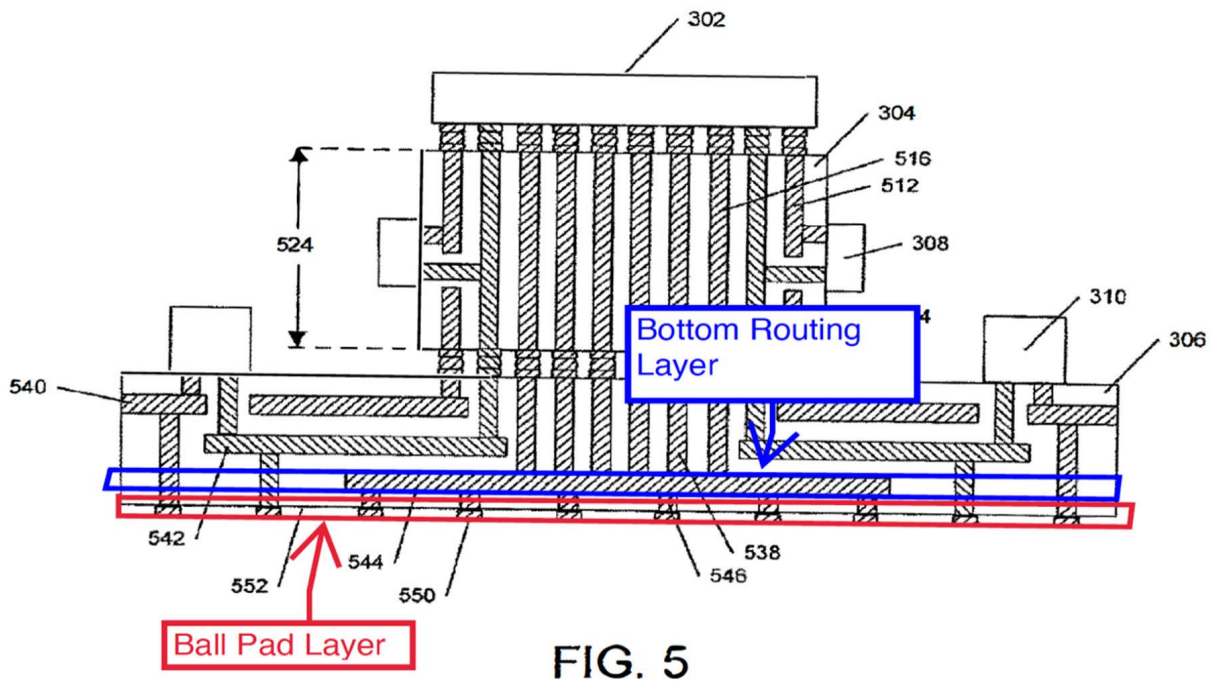
Mr. Taylor: Objection, form.

A: Yeah. The portion that is made up of the vertical package section 304 is perpendicular to the horizontal packaging Section 306.

(EX2004, 83:20–84:4; EX2003, ¶294.)

As shown in Fig. 5 of Chung (reproduced below with Petitioner's

annotations), Petitioner identifies the conductive layer 544 in the horizontal section of Chung as corresponding to the bottom routing layer of claim 1. (EX2003, ¶295.)



However, Petitioner provides no evidence that forming a clear area in the center of the bond pad layer 550 in Chung is necessary to prevent damage to a signal trace of a conductive layer in the horizontal package section during thermal cycling. (EX2003, ¶296.) Neither Celeron nor any of the other references cited in the Petition teach that the corner of a die mounted on top of vertical layers would be associated with increased stress in horizontal layers disposed perpendicularly below the vertical layers. (EX2003, ¶297.) Absent evidence showing same, there would be no motivation to combine Chung and Celeron in the manner proposed. (EX2003, ¶298.)

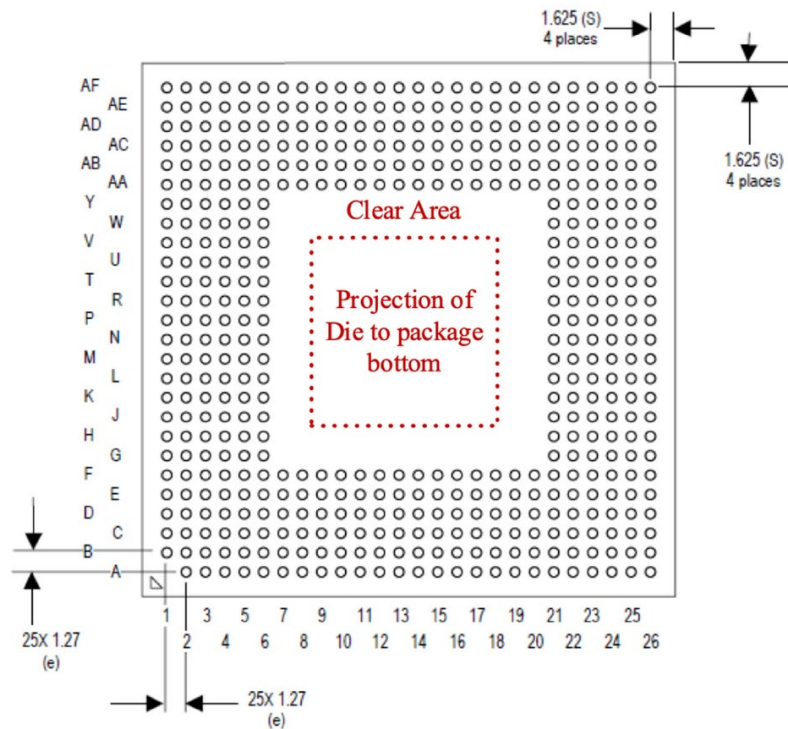
In fact, since one of the functions of the horizontal section in Chung can be to convert the pitch along the x-axis from the bond pad pitch of the IC to a larger bond pad pitch in the bond pad layer², (EX1006 at [0038]), and whereas forming a clear area in the bond pad layer like Celeron would tend to reduce pitch by reducing the area available for the bond pads, there would actually be no reason to combine Chung and Celeron as proposed. (EX2003, ¶299.)

Even if there were motivation to combine Chung and Celeron as proposed, the proposed Chung-Celeron combination would not include ball pads in an area within two ball pad pitches of the of the corner of the die as required by claim 1. (EX2003, ¶300.) In the proposed combination of references in Ground 7, Petitioner admits that Chung does not explicitly show that “none of the signal traces of the bottom routing layer are located over ball pads of the ball pad layer which are

² Petitioner alleges that bond pads 550 in Figure 5 of Chung correspond to the ball pad layer of claim 1. (Pet. at 48.) However, it should be noted that, contrary to Petitioner's assertions, bond pads are not the same as ball pads. (EX2003, ¶299.) Ball pads serve as mounts for solder balls, whereas bond pads form connections with solder balls. (EX1006 at [0053]; EX2003, ¶299.) The proposed combination fails for this reason as well.

disposed in an area within two ball pad pitches of the corner of the die,” (Pet. at 48), and relies on Celeron for this limitation, (*id.* at 48–53). (EX2003, ¶301.) However, as admitted by Petitioner, “Celeron discloses that there are no ball pads in the ball pad layer ‘disposed in an area within two ball pad pitches of the corner of the die.’” (Pet. at 52; EX2003, ¶302.) Thus, the proposed combination would not have “ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die.” (EX2003, ¶303.)

This deficiency is clearly shown in annotated Figure 30 of Celeron (Pet. at 51), reproduced below, in which a large area surrounding the corner of the die is free of ball pads. (EX2003, ¶304.) Petitioner even labels the area around the die without ball pads as “Clear Area.” (EX2003, ¶305.)



Moreover, Chung and Celeron both fail to show the signal traces, so even if there were ball pads in the “Clear Area,” it has not been proven that their combination would meet the claim limitation “wherein none of the signal traces of the bottom routing layer are located over ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die,” in claim 1. (EX2003, ¶306.)

Petitioner's expert confirmed that Chung-Celeron lacks important limitations:

Q: And does the combination proposed in paragraph 141 of your declaration include ball pads within two ball pad pitches of the corner of the die?

MR. TAYLOR: Objection, form.

A: The ball pads in the combination are not within two ball pad pitches of the corner of the die. They would be outside the corner of the die as I discussed in paragraphs 140 and 141.

(EX2004, 94:12–20; EX2003, ¶307.)

For at least the above reasons, Chung-Celeron fails to render claim 1 obvious.

(EX2003, ¶308.)

Claims 2 and 5 depend from claim 1. (EX2003, ¶ 309.) A dependent claim contains all of the limitations of the claim or claims from which it depends. (EX2003, ¶310.) Therefore, claims 2 and 5 distinguish over Chung-Celeron for at least the same reasons discussed above with regard to claim 1. (EX2003, ¶311.)

6. Ground 8: Chung-Celeron-Pillai Do Not Render Obvious Claim 3

Claim 3 depends from claim 1. (EX2003, ¶312.) A dependent claim contains all of the limitations of the claim or claims from which it depends. (EX2003, ¶313.) Ground 8 does not rely on Pillai to overcome the deficiencies of Chung-Celeron noted above with respect to claim 1, from which claim 3 depends. (EX2003, ¶314.) Therefore, claim 3 distinguishes over Chung-Celeron-Pillai for at least the same reasons noted above in the discussion of claim 1 with regard to Ground 7. (EX2003, ¶15.) In any event, Chung, Celeron, and Pillai are all silent regarding metal traces on the bond pad layer being connected to bond pads. (EX2003, ¶316.) The vias in Pillai are for connecting the ball pads to other layers

of the package. (EX2003, ¶317.) The partial cross-section in FIG. 1 of Pillai, by itself, is insufficient to prove that Pillai lacks metal traces connected to bond pads anywhere else on the bond pad layer or to provide motivation to forego metal traces on the bond pad layer. (EX2003, ¶318.) Claim 3 is submitted to be patentable over Chung-Celeron-Pillai for these additional reasons. (EX2003, ¶319.)

7. Ground 9: Obviousness of Claim 4 Over Chung-Celeron-AAPA

Claim 4 depends from and contains all the limitations of claim 1. (EX2003, ¶320 & 321.) Ground 9 does not rely on the purported AAPA to overcome the deficiencies of Chung-Celeron with respect to claim 1, from which claim 4 depends. (EX2003, ¶322.) Therefore, claim 4 is submitted to be patentable over Chung-Celeron-AAPA for at least the same reasons discussed above with regard to claim 1. (EX2003, ¶323.)

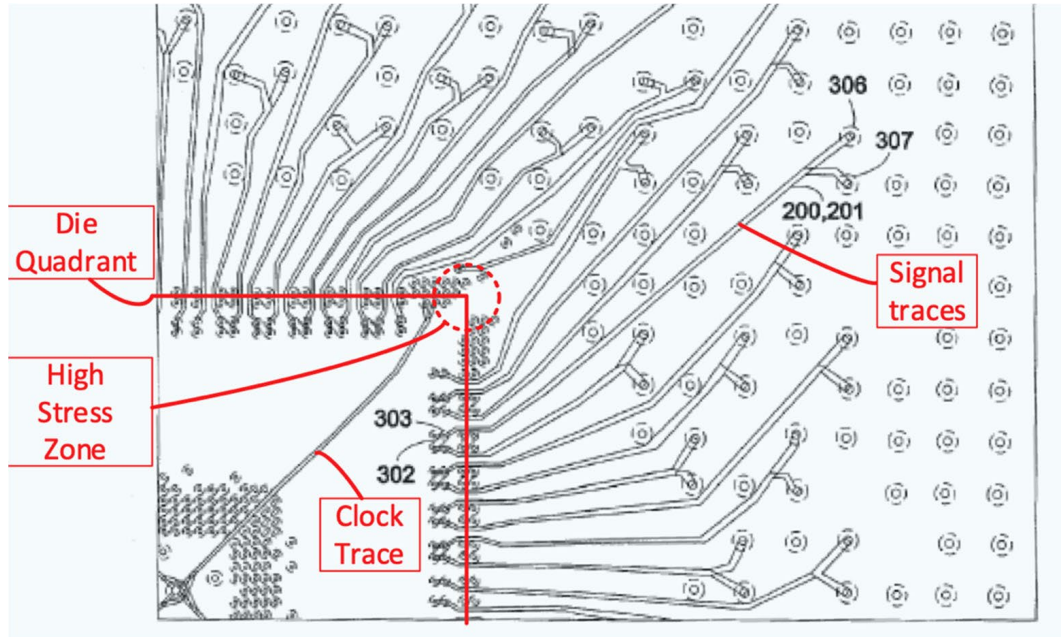
8. Ground 10: Obviousness of Claim 6 over Chung in view of Celeron and Tanahashi

Claim 6 depends from and contains all the limitations of claim 1. (EX2003, ¶324.) Since Petitioner relies on Tanahashi for allegedly disclosing the additional limitations of claim 6, not for overcoming the deficiencies of Chung-Celeron with respect to claim 1, claim 6 is patentable over Chung-Celeron-Tanahashi for at least the same reasons as discussed above with regard to claim 1. (EX2003, ¶325-327.)

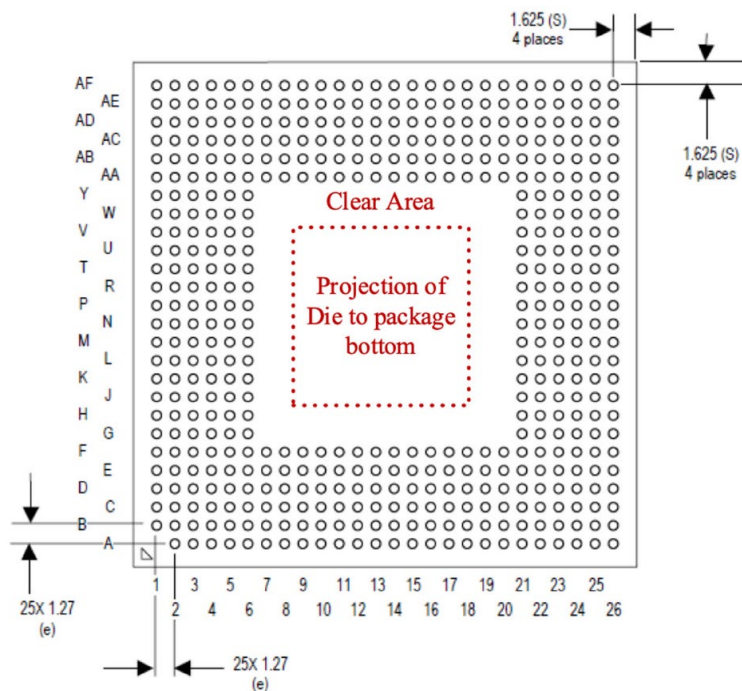
Claim 6 is further submitted to be patentable over Chung-Celeron-Tanahashi for the additional limitations it recites because Petitioner's annotations of Figure 3B of Tanahashi, by themselves, are insufficient to prove that the power wiring conductor P1 in FIG. 3C of Tanahashi is a voltage bus bar on the bottom routing layer. (EX2003, ¶328.)

9. Ground 11: Obviousness of Claims 1 and 5 Over Devnani in View of Celeron

Petitioner fails to show that Devnani-Celeron would render claim 1 obvious because, as noted above in Section V.A.4(c) (Ground 4) and Section V.A.7 (Ground 7), the limitation “ball pads of the ball pad layer which are disposed in an area within two ball pad pitches of the corner of the die” in claim 1 should be construed to mean “wherein the plurality of ball pads includes ball pads disposed in an area within two ball pad pitches of the corner of the die and wherein none of the signal traces of the bottom routing layer are located over the ball pads in the area,” and neither Devnani Figure 3 nor Figure 30 of Celeron have ball pads within such an area relative to the die corner. (EX2003, ¶329.) *See* Petitioner's Annotated Figure 3 of Devnani (EX1005) and Petitioner's Annotated Figure 30 of Celeron (EX1008) reproduced below.



(Devnani, Figure 3 (Annotated by Petitioner).)



(Celeron, Figure 30 (Annotated by Petitioner); (EX2003, ¶330).)

As such, neither would experience the problem described in the '245 Patent

and, even if combined, the proposed combination would not have ball pads in Petitioner's alleged high stress zone around the corner of the die. (EX2003, ¶331.) Therefore, the proposed combination would not include all the limitations of claim 1, which require ball pads in such a zone around a corner of a die. (EX2003, ¶332.)

Claim 5 depends from claim 1. (EX2003, ¶333.) Since a dependent claim contains all of the limitations of the claim or claims from which it depends, claim 5 distinguishes over Devnani-Celeron for at least the same reasons discussed above with regard to claim 1. (EX2003, ¶334.)

10. Ground 12: Claim 6 Is Not Rendered Obvious by Devnani-Celeron-Tanahashi

Claim 6 depends from and, therefore, contains all the limitations of claim 1. Since Petitioner relies on Tanahashi for allegedly disclosing the additional limitations of claim 6, not for overcoming the deficiencies of Devnani-Celeron with respect to claim 1, claim 6 distinguishes over Devnani-Celeron-Tanahashi for at least the same reasons as discussed above in regard to claim 1. (EX2003, ¶335-337.) Claim 6 is further submitted to be patentable for the additional limitations it recites because Petitioner's annotations of Figure 3B of Tanahashi, by themselves, are insufficient to prove that the power wiring conductor P1 in FIG. 3C of Tanahashi is a voltage bus bar on the bottom routing layer. (EX2003, ¶338.)

Case IPR2024-00168
Patent No. 7,345,245
Patent Owner's Response

XX. CONCLUSION

Patent Owner respectfully requests the Board find the challenged claims to be patentable for the reasons stated herein.

Dated: August 21, 2024

Respectfully submitted,

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Case IPR2024-00168
Patent No. 7,345,245
Patent Owner's Response

CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME LIMITS

This Patent Owner Response consists of 13,966 words, excluding cover page, table of contents, table of authorities, certificate of service, this certificate, or table of exhibits. Thus, the Patent Owner Response complies with the type-volume limitation of 14,000 words as mandated in 37 C.F.R. §42.24. In preparing this certificate, counsel has relied on the word count of the word-processing system used to prepare the paper (Microsoft Word).

Dated: August 21, 2024

Respectfully submitted,

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Case IPR2024-00168
Patent No. 7,345,245
Patent Owner's Response

CERTIFICATE OF SERVICE

I hereby certify that on August 21, 2024, the foregoing document was served
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