



UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,
Petitioner,

v.

GREENTHREAD, LLC,
Patent Owner.

IPR2024-00469
U.S. Patent No. 9,190,502

PATENT OWNER'S SUR-REPLY

TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. ARGUMENT	2
A. Under <i>INVT</i> , Petitioner must show that the cited references actually move carriers from the “surface layer.”	2
B. Petitioner relies upon an incorrect claim construction of “aid the movement of minority carriers.”	5
C. Petitioner presented <i>zero</i> evidence that Kawagoe is <i>even</i> capable of moving a carrier, much less a minority carrier, from the “surface layer.”	6
D. Petitioner presented <i>zero</i> evidence that Onoda is <i>even</i> capable of moving a carrier, much less a minority carrier, from the “surface layer.”	12
E. Petitioner presented <i>zero</i> evidence that the cited references move “ <i>minority</i> carriers” from the “surface layer.”	17
F. PO’s prior licenses are objective indicia of non-obviousness that support patentability.	23
G. Petitioner has not shown that the Petition is timely.	24
III. CONCLUSION.....	24

TABLE OF AUTHORITIES

	Page(s)
Cases	
<i>Apps. in Internet Time, LLC v. RPX Corp.</i> , IPR2015-01750, Paper 128 (PTAB Oct. 2, 2020)	24
<i>INVT SPE LLC v. Int’l Trade Comm’n</i> , 46 F.4th 1361 (Fed. Cir. 2022)	1, 2, 3, 4
<i>Kaken Pharm. Co. v. Iancu</i> , 952 F.3d 1346 (Fed. Cir. 2020)	6
<i>KEYnetik, Inc. v. Samsung Elecs. Co., Ltd.</i> , 837 Fed. Appx. 786 (Fed. Cir. 2020)	6
<i>Multiform Desiccants, Inc. v. Medzam, Ltd.</i> , 133 F.3d 1473 (Fed. Cir. 1998)	18, 19
<i>Netword, LLC v. Centraal Corp.</i> , 242 F.3d 1347 (Fed. Cir. 2001)	18
<i>ParkerVision, Inc. v. Qualcomm Inc.</i> , 903 F.3d 1354 (Fed. Cir. 2018)	1, 2, 4
<i>In re Power Integrations, Inc.</i> , 884 F.3d 1370 (Fed. Cir. 2019)	18
<i>Quanergy Sys., Inc. v. Velodyne Lidar USA, Inc.</i> , 24 F.4th 1406 (Fed. Cir. 2022)	23
<i>Sequoia Tech., LLC v. Dell, Inc.</i> , 66 F.4th 1317 (Fed. Cir. 2023)	6, 19
<i>Stratoflex, Inc. v. Aeroquip Corp.</i> , 713 F.2d 1530 (Fed. Cir. 1983)	23
<i>SynQor, Inc. v. Artesyn Techs., Inc.</i> , 709 F.3d 1365 (Fed. Cir. 2013)	22
<i>U.S. v. Adams</i> , 383 U.S. 39, 76 S.Ct. 708 (1966)	18



<i>Worlds Inc. v. Bungie, Inc.</i> , 903 F.3d 1237, 1244 n.8, 1246 (Fed. Cir. 2018)	1, 24
--	-------

EXHIBIT LIST

Exhibit No.	Description	Submitted Previously
Ex. 2001	<i>Greenthread, LLC v. Intel Corp.</i> , No. 6:22-cv-00105-ADA, Dkt. 1 (Complaint) (W.D. Tex. Jan. 27, 2022)	X
Ex. 2002	<i>Greenthread, LLC v. Intel Corp.</i> , No. 6:22-cv-00105-ADA, Dkt. 7 (summons returned executed) (W.D. Tex. Feb. 7, 2022)	X
Ex. 2003	<i>Greenthread, LLC v. Intel Corp.</i> , 6:22-cv-00105-ADA, Dkt. 38 (First Amended Complaint for Patent Infringement) (W.D. Tex., filed Apr. 29, 2022)	X
Ex. 2004	<i>Greenthread, LLC v. Intel Corp.</i> , No. 6:22-cv-00105-ADA, Dkt. 113 (Redacted Memorandum Opinion and Order) (W.D. Tex. Dec. 27, 2022)	X
Ex. 2005	<i>Greenthread, LLC v. Intel Corp.</i> , 6:22-cv-00105-ADA, Dkt. 38-8 (Greenthread's Amended Preliminary Infringement Contentions) (W.D. Tex., filed Apr. 29, 2022)	X
Ex. 2006	<i>Greenthread, LLC v. Intel Corp.</i> , 6:22-cv-00105-ADA, Dkt. 38-12 (Exs. D-1, D-2, D-3, D-6 to Greenthread's Preliminary Infringement Contentions) (W.D. Tex., filed Apr. 29, 2022)	X
Ex. 2007	<i>Greenthread, LLC v. Intel Corp.</i> , 6:22-cv-00105-ADA, Dkt. 49 (Notice of Appearance of Additional Counsel) (W.D. Tex., filed June 9, 2022)	X
Ex. 2008	Petition (Paper 1) in <i>Sony Group Corp. v. Greenthread, LLC</i> , IPR2023-00376	X

Exhibit No.	Description	Submitted Previously
Ex. 2009	<i>Greenthread, LLC v. Dell Inc.</i> , No. 6:22-cv-105-ADA, Dkt. 120 (Second Amended Complaint)	X
Ex. 2010	<i>Greenthread, LLC v. Intel Corp.</i> , 6:22-cv-00105-ADA, Dkt. 135 (Motion for Admission Pro Hac Vice of L. Popovski on Behalf of Sony) (W.D. Tex., filed January 30, 2023)	X
Ex. 2011	[SEALED] Confidential agreement	X
Ex. 2012	[SEALED] Confidential declaration	X
Ex. 2013	February 5, 2024 Neil Ozarkar email to the counsel regarding IPR2014-00468, -00469, -00470	X
Ex. 2014	February 21, 2024 Miguel Bombach email to counsel regarding IPR2014-00468, -00469, -00470	X
Ex. 2015	March 6, 2024 Arvind Jairam email to the Board regarding IPR2014-00468, -00469, -00470	X
Ex. 2016	Greenthread's December 13, 2023 Preliminary Infringement Contentions to Monolithic	X
Ex. 2017	Monolithic Power Systems, Inc., Investor/Analyst Day 2018 Presentation	X
Ex. 2018	Monolithic Power Systems, Inc. Q2 2021 Earnings Call Transcript	X
Ex. 2019	Monolithic Power Systems, Inc. Data Sheet MP2953B Intel VR12.5 Compliant Controller	X
Ex. 2020	Monolithic Power Systems, Inc. LinkedIn post regarding Sony PlayStation 5	X

Exhibit No.	Description	Submitted Previously
Ex. 2021	May 2, 2015 Investor's Business Daily, "Sony PlayStation 4 Chipmaker Monolithic Power Systems Tops Q1 Views"	X
Ex. 2022	Monolithic Power Systems, Inc. 2023 Form 10-K	X
Ex. 2023	Petition (Paper 2) in <i>Sony Group Corp. v. Greenthread, LLC</i> , IPR2023-00324	X
Ex. 2024	Petition (Paper 3) in <i>Sony Group Corp. v. Greenthread, LLC</i> , IPR2023-00325	X
Ex. 2025	Petition (Paper 1) in <i>Sony Group Corp. v. Greenthread, LLC</i> , IPR2023-00375	X
Ex. 2026	<i>Greenthread, LLC v. Monolithic Power Systems, Inc.</i> , No. 23-cv-579, Dkt. 1 (Complaint with accompanying exhibits) (D. Del. May 26, 2023)	X
Ex. 2027	<i>Greenthread, LLC v. ON Semiconductor Corp.</i> , No. 23-443-RGA, Dkt. 24 (Scheduling Order) (D. Del. Sept. 11, 2023)	X
Ex. 2028	Definition of "agent" in Black's Law Dictionary (11 th ed. 2019) available from Westlaw at westlaw.com	X
Ex. 2029	Joint Claim Construction Brief [Defendants' Answering Positions], <i>Greenthread, LLC v. Monolithic Power Systems, Inc.</i> , No. 23-cv-579 (D. Del.) (served April 12, 2024)	X
Ex. 2030	U.S. Patent No. 8,704,292 to Disney	X
Ex. 2031 to 2033	[RESERVED]	

Exhibit No.	Description	Submitted Previously
Ex. 2034	Confidential agreement	X
Ex. 2035 to 2055	[RESERVED]	
Ex. 2056	Excerpts of the Deposition Transcript of Scott Warrick taken on June 7, 2024 along with marked Exhibits 3-5 in <i>Greenthread, LLC v. Cirrus Logic, Inc.</i> , 1:23-cv-00369-DC (W.D. Tex.)	X
Ex. 2057	Declaration of Dr. Alexander Glew	X
Ex. 2058	Transcript of Deposition of Dr. Stephen A. Campbell	X
Ex. 2059	Excerpts from Chen, J. Y., <u>CMOS Devices and Technology for VLSI</u> , Prentice-Hall (1990)	X
Ex. 2060	U.S. Patent No. 8,421,195	X
Ex. 2061	CV of Dr. Alexander Glew	X
Ex. 2062	U.S. Patent No. 9,190,502	X
Ex. 2063	U.S. Patent No. 10,510,842	X
Ex. 2064	U.S. Patent No. 11,121,222	X
Ex. 2065	U.S. Patent No. 10,734,481	X

Exhibit No.	Description	Submitted Previously
Ex. 2066	U.S. Patent No. 11,316,014	X
Ex. 2067	File History of U.S. Patent No. 9,190,502	X
Ex. 2068	File History of U.S. Patent No. 10,510,842	X
Ex. 2069	File History of U.S. Patent No. 11,121,222	X
Ex. 2070	File History of U.S. Patent No. 10,734,481	X
Ex. 2071	File History of U.S. Patent No. 11,316,014	X
Ex. 2072	Declaration of Mohan Rao	X
Ex. 2073	Statista Information	X
Ex. 2074	<i>Greenthread, LLC v. Cirrus Logic Inc.</i> , No. 1:23-cv-369-DC-DTG, Dkt. 53 (Claim Construction Order and Memorandum in Support Thereof) (W.D. Tex. Mar. 13, 2024)	X
Ex. 2075	<i>Greenthread, LLC v. Samsung Electronics Co., Ltd. Et Al.</i> , 2:19-cv-00147, Dkt. No. 67 (Claim Construction Memorandum Opinion and Order) (E.D. Tex. Apr. 20, 2020)	X
Ex. 2076	<i>Intel Corp. v. Greenthread LLC</i> , IPR2023-00548, Ex. 1003 (Dr. Blalock Declaration), Jan. 30, 2023	X



Exhibit No.	Description	Submitted Previously
Ex. 2077	<i>Greenthread, LLC v. Cirrus Logic, Inc.</i> , No. 1:23-cv-00369-DC, Dkt. 86 (W.D. Tex. Jul. 11, 2024)	X
Ex. 2078 to 2084	[RESERVED]	
Ex. 2085	Transcript of Deposition of Dr. Stephen A. Campbell, <i>Monolithic Power Systems, Inc. v. Greenthread, LLC</i> , IPR2024-00550, -00551, -00552, -00553, November 22, 2024.	

I. INTRODUCTION

PO recently filed Director Review requests in IPR2023-01242 to -01244 (“OnSemi IPRs”). These requests are also relevant to IPR2024-00468 to -00470 (“Monolithic IPRs”). Under *Worlds*, Petitioner has the burden to produce “actual evidence” to prove lack of privity. 903 F.3d 1237, 1244 n.8, 1246 (Fed. Cir. 2018). But Petitioner presented **zero** “actual evidence.” Should the Director reverse the FWDs and terminate the OnSemi IPRs, the Board should immediately terminate all of the Monolithic IPRs as well.

Petitioner also has the burden to prove that the cited references have a “graded concentration of dopants [GDC] generating a first static unidirectional drift field to aid the movement of minority carriers from [the] surface layer,” where an “active region” is located. EX1001 (’502 patent), 55-62. In order for the GDC to do this, the GDC must (1) create an electric field that is in the **correct** location; (2) the electric field must point in the **correct** direction; and (3) the electric field must have sufficient magnitude to overcome other forces in the “surface layer.” POR (Paper 35), 9, 17, 19, 21, 25 (citing EX2057, ¶¶ 55-56, 60). But Petitioner has presented **zero** evidence on these points.

Instead, Petitioner argues that under *ParkerVision*, it must only show that the cited references are merely “capable” of performing the claimed limitations. But this is **not** the test. The Federal Circuit made it clear in *INVT* that not all apparatus

claims are the same, and for apparatus claims with “structural limitations,” like a GDC and a “static unidirectional electric drift field,” Petitioner must show that the claimed structures *actually perform* the claimed limitations.

Whether the Board uses the correct test under *INVT*, or the incorrect test under *ParkerVision*, the Petitioner cannot meet its burden either way. Kawagoe and Onoda *never* mention moving carriers, much less minority carriers, from the “surface layer.” In Kawagoe, the alleged GDC is merely used to keep SEU electrons *out* of the well region. In Onoda, the dopant concentration is flat in the “surface layer” (*i.e.*, there is no GDC, much less one that would move minority carriers from the “surface layer”). Therefore, there is no evidence that either reference is *even* “capable” of moving minority carriers *from* the “surface layer.”

II. ARGUMENT

A. Under *INVT*, Petitioner must show that the cited references actually move carriers from the “surface layer.”

The Federal Circuit has *never* said that the test for obviousness—for *all* apparatus claims—is whether the prior art is “capable” of performing the claimed limitation. In fact, the Federal Circuit has made it clear that there are “configuration-type *apparatus* claims” and “capability-type *apparatus* claims.” *INVT SPE LLC v. Int’l Trade Comm’n*, 46 F.4th 1361, 1372-72 (Fed. Cir. 2022) (citing *ParkerVision*). The type of claim does *not* turn on whether the claim is an apparatus or a method

claim. *Id.* at 1372. Rather, it “depend[s] on the claim language,” since “differences exist between apparatus claims.” *Id.* at 1371.

The Federal circuit has recognized that for “mechanical apparatus claims” (as opposed to computer or software claims), the claims are “configuration-type claims.” *Id.* at 1371-72 (citing *Ball Aerosol* and *Cross Medical*). Here, the claims are clearly “mechanical apparatus claims.” The claims require a “graded concentration of dopants...to aid the movement of minority carriers *from* said surface layer *to* said substrate.” EX1001, 4:59-2. The claims recite a specific structure (*i.e.*, a GDC) that “aids the movement of minority carriers” from a first location (*i.e.*, “surface layer” where the “active region” is located) to a second location (*i.e.*, “substrate”). *Id.* As the specification explains, the GDC creates “a suitable aiding drift electric field.” *Id.*, 2:47-48; EX1055, 161:24-162:15. In the embodiment shown in Figure 5(b), the GDC “creates a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface.” *Id.*, 3:39-42. The claims *never* say the GDC is “capable” of moving minority carriers. Rather, the claims and specification make it clear that the minority carriers move “as quickly as possible.” When, as here, an apparatus claim requires a specific structure to perform a specific limitation, the Petitioner must prove that the cited references *actually perform* that limitation. *See INVT*, 46 F.4th at 1371.

Instead, Petitioner relies on a misleading quote from *INVT*'s predecessor, *ParkerVision*, to dismiss PO's arguments as "unsupported." Reply (Paper 42), 2-3. But Petitioner cannot simply ignore a critical limitation of the claims. The claims do not require a GDC that is merely "capable" of moving minority carriers from the "surface layer." Instead, they require a GDC that *actually moves* carriers from the "surface layer."

As PO explained in the parallel Cirrus Logic IPRs, *ParkerVision* does not apply to the Challenged Claims. IPR2024-00017, Paper 75 (Hearing Tr.), 51:6-7. The claims-at-issue in *ParkerVision* "recite[d] ***no structural limitations*** that would preclude a prior art reference that discloses a different structure from performing the claimed function." *ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1362 (Fed. Cir. 2018) (emphasis added). PO's claims are clear that "aid[ing] carrier movement" can only be achieved by a GDC. There is no "different structure" that can "perform the claimed function." The Challenged Claims are entirely distinguishable from the claims-at-issue in *ParkerVision*, *Ericsson*, and *Finjan*. In those cases, the claims recited software "modules," or other generic components, that did not require "actual performance of [the] operative steps." *INVT*, 46 F.4th at 1372-73.

Throughout its Reply, Petitioner erroneously suggests that because the Challenged Claims are directed to an apparatus, "physical movement of a 'minority carrier'...is not required by the claims or to establish obviousness." Reply, 1. But

the type of claim does *not* turn on whether it is an *apparatus* or *method* claim. Rather, it depends on the nature of the claim and the actual claim language. Petitioner *never* provided *any* justification (nor can it) for why a mechanical, non-computer, non-software claim that recites a specific structure (“GDC”) for moving the minority carriers, should be read to mean the GDC does *not* actually have to move them.

B. Petitioner relies upon an incorrect claim construction of “aid the movement of minority carriers.”

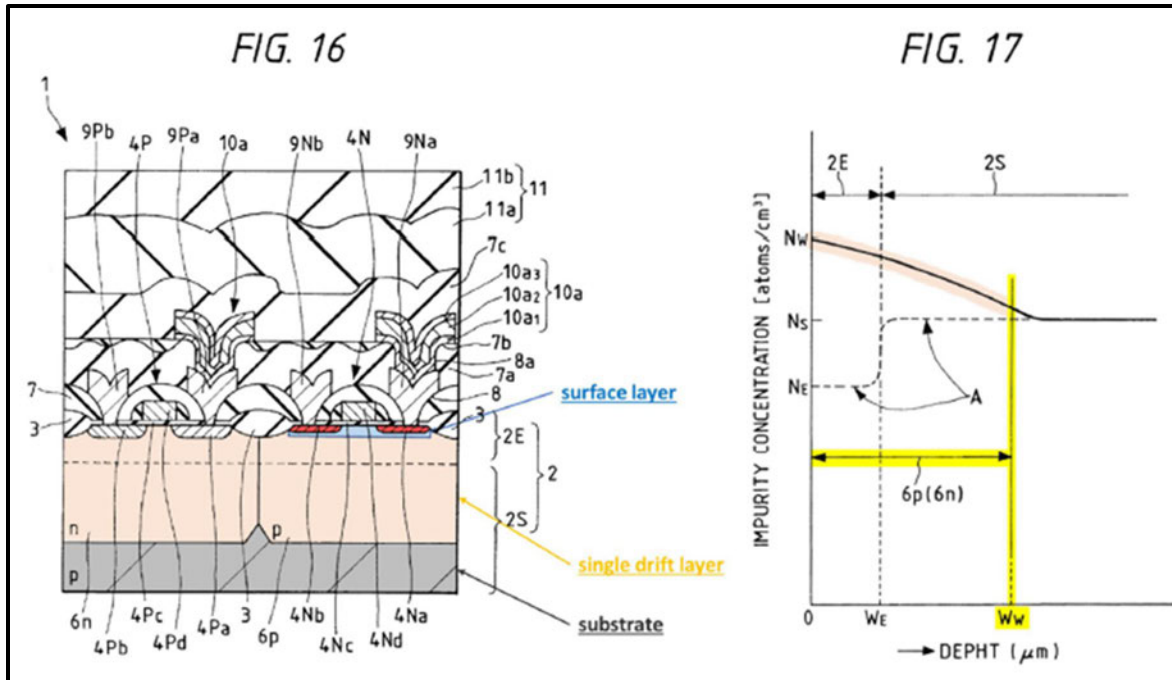
In its Reply, Petitioner adopts a new and incorrect claim construction by alleging that PO “improperly injects limitations requiring carrier movement” into the claims. Reply, 2. But Petitioner’s construction—that actual movement is not required—does render the claimed limitation superfluous. To use an analogy, this is like arguing that a person can “aid movement” by pushing on a parked car. EX1055, 67:25-68:19. Even Petitioner’s own expert understood “aiding carrier movement” to refer to “sweeping carriers from the active circuitry at the surface into the substrate.” EX1003, ¶¶ 25, 35 (cleaned up). “Sweeping” the carriers means “moving” the carriers, and to argue otherwise is contrary to the surrounding claim language and the patent’s specification. Furthermore, this position is contrary to Petitioner’s position in district court that the claims require actual movement. EX2030, 45 (“POSITA has no way to be reasonably certain that ‘minority carrier movement’ has been aided if minority carriers need not actually move.”); POR, 8.



To improve performance of the claimed transistor, the minority carriers must not only *move*, but they must *move in the correct direction, from* the “surface layer” to deeper in the substrate. The Federal Circuit has made it clear that claims should be construed to properly reflect the “purpose of the invention.” *Sequoia Tech., LLC v. Dell, Inc.*, 66 F.4th 1317, 1326 (Fed. Cir. 2023) (“The specification further supports this construction. We have explained that a patent’s express purpose of the invention ‘informs the proper construction of claim terms.’”) (quoting *Kaken Pharm. Co. v. Iancu*, 952 F.3d 1346, 1352 (Fed. Cir. 2020)). Here, Petitioner relies upon an incorrect claim construction that “would eviscerate the stated purpose of the claimed invention.” *KEYnetik, Inc. v. Samsung Elecs. Co., Ltd.*, 837 Fed. Appx. 786, 792 (Fed. Cir. 2020).

C. Petitioner presented *zero* evidence that Kawagoe is *even* capable of moving a carrier, much less a minority carrier, from the “surface layer.”

In its Petition, Petitioner cites to Kawagoe’s Figures 16 and 17 for the “graded concentration of dopants...to aid the movement of minority carriers from [the] surface layer” limitation.



Pet., 66-70. But Kawagoe *never* mentions moving carriers, much less moving carriers from the “surface layer.” The best Petitioner could do was cite to the following *altered* sentence: “electrons produced by the α -ray are attracted to the substrate body 2S by that concentration gradient,” *id.*, 67, while removing the second half saying that the electrons are “prevented from entering the p-well 6p,” EX1007, 16:7-11. But whatever Kawagoe is doing, it is in the *wrong* location. As PO explained in its POR, Kawagoe is *not* moving carriers from the “surface layer,” where the “active region” is located. POR, 2, 22-25. Instead, it is preventing electrons produced by the α -ray (*i.e.*, the SEU electrons) from entering the p-well. *Id.*, 22-24; EX2057, ¶¶ 62, 66 (“Kawagoe does not address carriers in the ‘active region,’ ...because Kawagoe’s carriers are nowhere near what the Petition identifies as the ‘surface’ or first/second ‘active regions.’”), EX2058. 43:8-20 (Dr. Campbell

[REDACTED]

explaining that Kawagoe’s “focus” is “reducing the carrier flow ... Upwards from the substrate”). When Kawagoe keeps the SEU electrons that are already in the substrate, in the substrate, this is clearly not the same as moving carriers *from* the “surface layer.” EX2057, ¶ 66; EX1055, 112:17-20 (“electrons below the P-well are acted upon by a field so that they stay in the substrate.”). It is telling that Kawagoe used the word “attracted” instead of the word “move.” When Kawagoe says the SEU electrons are *attracted* to the substrate, it simply means the SEU electrons *stay* in the substrate.

In its Reply, Petitioner argues that Dr. Glew admitted that Kawagoe pushes electrons downward from the surface. Reply, 21-22. This is *not* true. When Dr. Glew was asked whether Figure 17 would sweep electrons from the active region, he answered: “electrons would be pushed *potentially* in the opposite direction to the right or downward.” EX1055, 122:14-123:3 (emphasis added). But in the very next line, Dr. Glew explained that “[t]his is an effect in isolation. Whether there was actually any motion or net effect would depend upon other forces acting upon the electron also.” *Id.*, 123:3-7; 65:13-19 (“the field would have to be of sufficient magnitude to overcome countervailing or counter balancing fields from other structures and materials in the semiconductor device.”). A few minutes earlier, Dr. Glew explained how “Kawagoe says that it keeps electrons from entering through the P-well. So it never mentions that it’s dealing with alpha particle generated

electrons above the P-well.” *Id.*, 117:7-12; *see also id.*, 120:20-121:5 (explaining that Kawagoe’s only “effect” is “preclud[ing] electrons from entering the P-well”), 122:1-13 (same). Thus, the only plausible reading of Kawagoe is that whatever Figure 17 is doing, Figure 17 is keeping the electrons “in the large substrate body below the wells” where they were produced. EX2057, ¶¶ 66, 68; EX1055, 120:10-19 (“The patent is specific and clear that below the P-well there’s sufficient forces to keep the electron from entering the P-well. It doesn’t make that same claim or assertion in the P-well or active area.”).

The Petition *never* identifies an electric field, much less the location, direction, and magnitude of the electric field. Instead, Petitioner relies entirely on the prosecution history. Pet., 67. In its Reply, Petitioner gravely misrepresents the prosecution history. To be exact, Petitioner states:

Applicant unequivocally committed itself to the position that a downward dopant gradient, by itself, “aid[s] the movement of minority carriers.”

PO argued that a downward dopant gradient—in itself—aids carrier movement and that a POSITA would understand as much.

Reply, 6-7. But this is *not* what Applicant said. Applicant actually said:

Yet, this argument appears to not consider that the graded dopant concentration itself creates a “built-in” electrical field that *forces* the movement of carriers into a *particular* direction, whereby the “direction” of the electrical field and the resulting direction of the carrier movement depends solely on the *slope* of the graded concentration of dopants.

EX1002, 289-290 (emphases added). Applicant *never* said a “downward-sloping dopant concentration” would sweep carriers down into the substrate. Rather, Applicant said the “direction” of the electric field, and the resulting direction of the carrier movement, depends on the *slope* of the “graded concentration.” *Id.* Whether the “resulting direction” is “up” or “down” (or whether the carrier moves at all) depends on a number of factors including:

- (1) Whether the dopants are n-type or p-type;
- (2) Whether the dopants are increasing or decreasing;
- (3) Whether the carrier is a hole or an electron;
- (4) Whether the electric field generates a force that is sufficient to overcome the resistance of the semiconductor;
- (5) Whether the resulting force is in the same direction or the opposite direction of another force; and
- (6) Whether the force is greater than or less than the other forces.

See EX2057, ¶¶ 35-37, 54-55, 57-58, 60, 63-65.

Petitioner *never* addressed any of these factors in its Petition or elsewhere. Even Petitioner’s expert admitted that other factors—which he did not analyze—affect carrier movement. EX2058, 34:1-36:19 (explaining that a “properly constructed” electric field has to “have a sufficient electric field intensity”), 39:8-12; EX2085, 43:21-46:14, 50:19-51:7, 139:20-140:11, 144:16-148:19. Even further, Petitioner admitted that Kawagoe is “silent” regarding the presence of other forces acting within the semiconductor device. Reply, 12. This is critical, since, as

Petitioner's expert explained, "[t]here may be other forces acting upon the carriers, and you have to add all of the forces" to determine movement. EX2085, 42:12-22. The net effect of the forces is what determines the movement of the minority carriers. *Id.*, 154:15-18, 46:18-47:1 ("a weak electric field that is pushing [minority carriers] down ... may not have enough force"), 52:22-53:9 (the "electric field due to a doping gradient ... is not as strong of a force as the electric field created by the gate."), 93:7-94:1 ("There are forces that overcome" the electric field). Dr. Campbell explained that it is "always true" that "under Newton's first law, [one] would have to look at the other forces in order to determine what actually happens" to a carrier. *Id.*, 95:11-17. PO's expert agrees. EX1055, 60:2-17 (explaining how a "POSITA would understand that one would need to account for whatever [other] forces existed"), 66:10-67:18, 91:12-14. As a result, Petitioner cannot prove that a force generated by Kawagoe's graded concentration is sufficient enough to possibly aid carrier movement. POR, 25 (citing EX2057, ¶¶54-56).

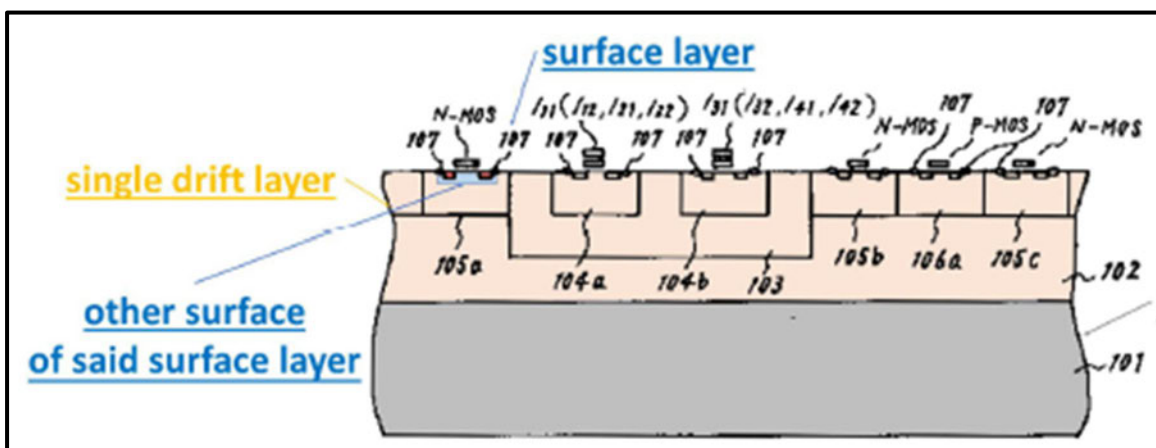
To summarize, Kawagoe never mentions moving carriers, much less moving carriers from the "surface layer." Dr. Glew never testified that Kawagoe would move carriers from the "surface layer." In fact, he confirmed that Kawagoe does *not* disclose moving carriers from the "surface layer." EX1055, 182:12-25. There is nothing in the prosecution history that would support this argument either. The prosecution history never said that a "downward sloping dopant concentration"

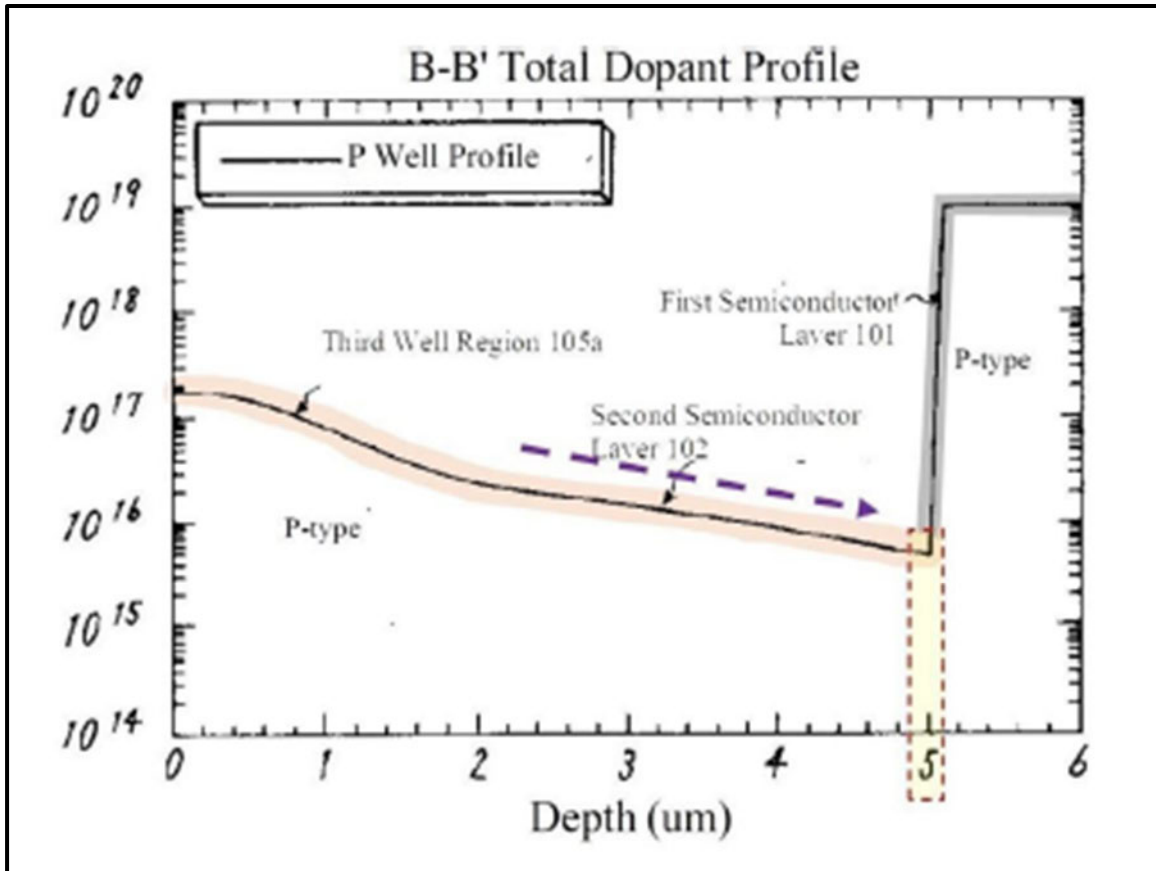
would “sweep carriers down into the substrate.” To the contrary, it said the movement will depend on the *slope* of the “graded concentration.” EX1002, 289-290; *see also* EX1055, 22:3-21.

Petitioner never identified an electric field, much less the location, direction, and magnitude of the electric field, or whether the electric field is sufficient to overcome other forces in the “surface layer.” Not only is there *no* evidence that Kawagoe moves carriers from the “surface layer,” there is also *no* evidence that Kawagoe is *even* capable of moving carriers from the “surface layer.”

D. Petitioner presented *zero* evidence that Onoda is *even* capable of moving a carrier, much less a minority carrier, from the “surface layer.”

In its Petition, Petitioner cites to Onoda’s Figures 3 and 11 for the “graded concentration of dopants...to aid the movement of minority carriers from [the] surface layer” limitation.





Pet., 30-34. But like Kawagoe, Onoda *never* mentions moving carriers, much less moving carriers from the “surface layer.” Petitioner provides no citations to the specification for this point. *Id.*, 31-32. Instead, Petitioner relies entirely on the pictures above. *Id.*

Onoda has a **uniform** concentration in the “surface layer” (where the “active regions” are located). For doping in the “surface layer,” the Petition points to Figure 11 and a conclusory sentence that “Onoda’s semiconductor device has a dopant profile whose impurities decrease from the surface, *i.e.*, depth 0, to the substrate., *i.e.*, depth of 5 um.” *Id.*, 31. But Figure 11 does **not** disclose a graded concentration



that would actually aid carrier movement where it is required—*from* the “surface layer.” The Petition cites to Onoda [0052] to explain that “there is no clear boundary between the third well region 105a and the second semiconductor layer 102, but rather the dopant concentration falls off smoothly.” *Id.*, 32. But that is not enough to show that Onoda’s dopant is sufficiently graded in the “surface layer” to aid carrier movement. In fact, Onoda is silent with respect to both reference 107 and the “surface layer” that Petitioner has overlayed on Figure 11. EX2058, 52:2-20 (“I can’t say exactly where [Onoda’s] active area would end.”), 55:9-56:6 (Onoda “doesn’t have any numbers on it.”). There is *zero* disclosure in Onoda discussing the depth of the “surface layer” or any characteristics of the dopant profile just below depth 0.

Even looking at Petitioner’s annotated Figure 11 demonstrates that the alleged “graded concentration” is flat throughout the surface layer. To be sure, Onoda’s dopant profile does decrease through the “third well region 105a,” but it does not “fall off smoothly” immediately below the surface (depth 0). Rather, the dopant profile does not begin to angle downward until approximately 0.5 μm . EX1055, 91:22-92:4, 94:7-13 (Dr. Glew explaining how “in the region of zero to about half-a-micron in Figure 11, the concentration appears to be flat or constant, roughly, in terms of concentration....Beyond half-a-micron, the concentration decreases.”); EX2058, 52:2-20 (agreeing that “the source drain depth was about half a micron”).

But again, Onoda is silent with respect to *where* the “surface layer” begins and ends. All Petitioner can point to is a general decreasing dopant profile across an entire span of 5 μm (which covers a well region 105a and an epitaxial layer 102). Onoda *may* disclose a dopant profile with a downward doping gradient from *somewhere below* the surface to the substrate, but it does not disclose, as Petitioner concludes, a “downward doping gradient *from* the surface to the substrate.” Pet., 32 (emphasis added); EX2058. 43:8-20 (Dr. Campbell explaining that Onoda’s “focus” is “reducing the carrier flow ... Upwards from the substrate”). Of course, since the dopant profile is flat in the surface layer, “there would be no force in the first half-micron exerted...by a field generated by this dopant profile.” EX1055, 94:10-12; 178:1-18 (“Because the dopant profile is flat, it does not generate an electric field near the surface. It is flat near the surface. Thus, it cannot move holes or electrons or any charged carrier.”).

Even if the concentration is graded within the “surface layer” (which it is not), Onoda never mentions using the grading to affect carrier movement. POR, 1, 17-18. Instead, Petitioner relies entirely on the prosecution history. Pet., 33-34. But once again, Petitioner gravely misrepresents the prosecution history. *Id.* Applicant never said that a “downward graded dopant profile” would “move carriers into the substrate.” *Id.*, 34. Rather, Applicant said the “direction” of the electric field, and the resulting direction of carrier movement, depends on the *slope* of the “graded

concentration.” EX1002, 289-290. Whether the resulting direction is “up” or “down” (or whether the carrier moves at all) depends on a number of factors and forces, as Dr. Campbell admits. EX2058, 34:15-36:19, 39:8-12; EX2085, 43:21-46:14, 50:19-51:7, 139:20-140:11, 144:16-148:19; POR, 17. But Petitioner has never addressed any of these factors in its Petition or elsewhere, and thus cannot determine that Onoda’s dopant profile and resulting field are “properly constructed.” EX1003, ¶ 32.

Nishizawa cannot save Onoda, since it does not teach moving carriers down *from* the surface layer. POR, 19-20. Just like Kawagoe (discussed above), Nishizawa was concerned with preventing carriers from moving *up* from the substrate. EX2057, ¶¶ 44-45; EX2058, 31:13-16, 43:8-20; EX1055, 96:18-21, 98:2-7, 106:14-18. Nishizawa is *silent* about affecting carriers in the surface layer, EX1046, 19:21-34, 20:19-22, and for the same reasons as Kawagoe, it does not teach the “aid the movement of minority carriers from [the] surface layer” limitation.

To summarize, Onoda never mentions moving carriers, much less moving carriers from the “surface layer.” Even if Petitioner can show that there is a graded concentration in the active region (which it cannot), there is no evidence that it would move carriers from the active region. EX1055, 92:5-16. Dr. Glew never testified that Onoda would move carriers from the “surface layer.” In fact, he confirmed that Onoda does *not* disclose moving carriers from the “surface layer.” *Id.*, 94:7-13;

178:1-18. There is nothing in the prosecution history that would support this argument either. The prosecution history never said that a “downward sloping dopant concentration” would “sweep carriers down into the substrate.” To the contrary, it said the movement will depend on the *slope* of the “graded concentration.” EX1002, 289-290; *see also* EX1055, 22:3-21.

Petitioner never identified an electric field, much less the location, direction, and magnitude of the electric field, or whether the electric field is sufficient to overcome other forces in the active region. Not only is there *no* evidence that Onoda moves carriers from the “surface layer,” there is also *no* evidence that Onoda is *even* capable of moving carriers from the “surface layer.”

E. Petitioner presented *zero* evidence that the cited references move “*minority* carriers” from the “surface layer.”

Just as Petitioner has not shown that the asserted references move carriers *from* the “surface layer,” Petitioner has not shown that the references move *minority* carriers *from* the “surface layer.”

In its Petition, Petitioner cites to Kawagoe’s Figure 17 for the “graded concentration of dopants...to aid the movement of minority carriers from [the] surface layer” limitation. But in Figure 17, the relevant transistor is an NMOs transistor, where the “majority” carrier is an electron, and the “minority carrier” is a hole. Petitioner, however, assumed that the minority carrier is an electron, and never

addressed what effect, if any, Kawagoe would have on a hole. Thus, Petitioner cannot possibly meet its burden.

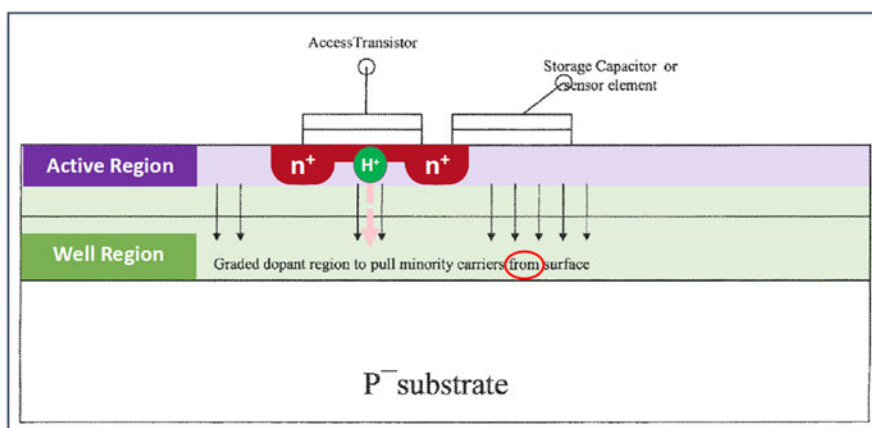
Similarly, the relevant transistor in Onoda's Figure 3 is an NMOS, where the "minority carrier" is a hole. Because Petitioner never address what effect, if any, Onoda would have on a hole, Petitioner cannot possibly meet its burden.

The Board must always "consider the claims in light of the specification and teachings in the underlying patent." *In re Power Integrations, Inc.*, 884 F.3d 1370, 1375 (Fed. Cir. 2019). "[B]oth are to be read with a view to ascertaining the invention." *U.S. v. Adams*, 383 U.S. 39, 49, 76 S.Ct. 708, 713 (1966). The claims "do not have meaning removed from the context from which they arose." *Netword, LLC v. Centraal Corp.*, 242 F.3d 1347, 1352 (Fed. Cir. 2001). When construing a term like "minority carrier," the Federal Circuit has held that the specification is the "best source for understanding a technical term." *Multiform Desiccants, Inc. v. Medzam, Ltd.*, 133 F.3d 1473, 1478 (Fed. Cir. 1998).

The specification explains that "MOS devices are majority carrier devices for conduction. The conduction is channel dominated." EX1001, 1:47-49; EX1055, 147:17-148:17. In other words, **majority** carriers are used for channel conduction. PO's expert understands this. EX2057, ¶ 36 n.3 ("Because the channel [of FIG. 5(b)] is formed by electrons with a negative charge, the MOSFET is referred to as an n-channel MOSFET, and the 'minority carriers' are holes."); EX1055, 58:6-8.

This is PO's position in prior litigation. *See* EX1030, 4 n.5 (same), 11 (“explaining MOS devices are majority carrier devices”). Petitioner knew or should have known that this is how the PO's patents understand majority/minority carriers. EX1055, 183:13-16. Petitioner cites PO's prior claim construction brief (EX1030) nearly thirty times in its Petition.

The specification is equally clear as to *why* this understanding of majority/minority carriers is critical, explaining how “[s]purious minority carriers” interfere with the “active circuitry at the surface” of a semiconductor device. EX1001, 3:25-42. PO's expert explained how, for the NMOS transistor of Fig. 5(b), “[w]hen enough electrons have accumulated, they form a conductive channel...between the source and the drain.” EX2057, ¶ 36. However, “the channel disappears as the holes return to the surface layer.” *Id.* Holes prevent the channel from forming. Since the claims are to be understood according to the “express purpose of the invention,” it is the *minority* carrier that has to be “[swept]...into the substrate as quickly as possible. EX1001, 3:30-33; *Sequoia Tech.*, 66 F.4th at 1326.



EX1001, Fig. 5(b) (annotated). For the NMOS of Figure 5(b), the minority carrier has to be holes. EX2057, ¶ 36 n.4. PO's expert was not "evasive" or "refused to answer [the] simple question[]" of "what constitutes a minority carrier," as Petitioner wrongly suggests. Reply, 23. In fact, Dr. Glew's deposition testimony was consistent that *holes* are minority carriers in an NMOS device. *See, e.g.*, EX1055, 38:10-39:5, 125:4-10, 126:15-18, 133:17-18, 136:10-14, 138:25-139:3, 149:4-17, 152:23-153:2, 154:25-155:12, 157:7-11, 176:17-22, 188:8-14. The electric field (indicated above) *must* point downward, since holes travel in the direction of the generated field, to move the minority carrier away from the "active region" or "surface layer" toward the substrate. *Id.*, 69:20-70:6, 158:13-18 ("The electric field is pointing downwards, and that electric field would pull holes or minority species downward away from the NMOS device.").

But this is not the understanding of "minority carrier" that Petitioner adopted. Petitioner's expert, Dr. Campbell, relies on the type of doping within a region to define which carrier is majority and which is minority. EX1003, ¶ 32 (contending that "the minority carriers [are] electrons in a p-type region"). This view of what defined majority/minority carrier status pervades his analysis for each of the Grounds. For Ground I, Dr. Campbell says that "minority carriers" in Onoda's NMOS move in the "opposite direction" of the field, *id.*, ¶¶ 72, 79, meaning that Dr. Campbell views electrons as "minority carriers." For Ground II, Dr. Campbell

again, incorrectly, defines “minority carriers” as electrons in an NMOS device. *Id.*, ¶¶ 89, 96. Lastly, for Ground III, Dr. Campbell adopts his “well region” understanding, concluding for the disputed limitation that “electrons are minority carriers in the p-well.” *Id.*, ¶¶ 111, 117. But Dr. Campbell’s—and Petitioner’s—understanding of what constitutes a minority carrier is inconsistent with how that term is used in the patent. EX1055, 130:4-7, 139:7-9. Tellingly, Dr. Campbell recognized that what a “minority carrier” is changes when looking at the channel. EX2085, 80:12-81:4 (stating that “[i]n the channel” of an NMOS device, “the *majority* carrier is electrons.”) (emphasis added). He elaborated further:

Q. And when you form an N-channel, what is the majority carrier in the channel?

A. For an NMOS device, it would be electrons.

Q. Okay. So, if we are talking about turning this transistor on and it forms an N-channel, that majority carrier in the N-channel is an electron, correct?

A. Correct.

Q. What is the minority carrier in the N-channel?

A. Holes.

Id., 98:16-99:5 (emphases added).

Not only is the Petition silent as to the references’ impact on “minority carriers,” but the Petition is incorrect in what a “minority carrier” even is. Properly understood, since “MOS devices are majority carrier devices,” an NMOS forms an

N-channel and a PMOS forms a P-channel. EX1001, 1:43. Thus, in an NMOS device, electrons are the majority carriers and holes are the minority carriers. EX1055, 128:7-12, 129:10-18, 160:2-19. In a PMOS device, it is the opposite; holes are the majority carriers and electrons are the minority carriers. Thus, the only way for the electric field in Fig. 5(b) to move the carrier from the “surface layer” to the substrate is if the carrier is a positively-charged hole. It would be physically impossible for the electric field to pull a negatively-charged electron, because the electron would move in the opposite direction (*i.e.*, *toward* the “active circuitry”). EX1055, 159:6-21 (“The electric field at 5B is pointed downwards. It only would pull holes downward. It would push electrons upward. It could not pull electrons downward.”); *see also id.*, 70:7-14, 75:1-5; EX2085, 95:11-17, 109:12-19 (Dr. Campbell agreeing that “the electric field shown in Figure 5B would cause holes to move in a downward direction and electrons to move in an upward direction”). If the minority carrier in an NMOS transistor were understood to be electron, it would inevitably exclude the specification’s preferred embodiment. *SynQor, Inc. v. Artesyn Techs., Inc.*, 709 F.3d 1365, 1378-79 (Fed. Cir. 2013) (“A claim construction that excludes the preferred embodiment is rarely, if ever, correct.”) (internal citation omitted).

Petitioner gets this critical point wrong. In addition to reciting the same arguments for the distinct “aid carrier movement” limitation from other patents,

[REDACTED]

Petitioner relies on its own understanding of majority and minority carriers, at odds with what the specification requires. EX1055, 175:9-21. Because Petitioner failed to produce any evidence for the correct “minority carrier,” Petitioner cannot possibly meet its burden.

F. PO’s prior licenses are objective indicia of non-obviousness that support patentability.

Petitioner has manufactured various issues regarding PO’s prior licenses with major semiconductor companies to avoid some of “the most probative and cogent evidence in the record.” *See Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983). There is zero doubt that there is a “legally and factually sufficient connection [*i.e.*, nexus] between the [licenses] and the patented invention.” *See, e.g., Quanergy Sys., Inc. v. Velodyne Lidar USA, Inc.*, 24 F.4th 1406, 1417 (Fed. Cir. 2022). Each license agreement covers a *single patent family* with nearly identical specifications, and the claimed feature of using a graded dopant *is* recited in the licenses. EX2078, ¶¶ 2-3, p. 19, 45. It is also undisputed that RPX *approached Greenthread* on behalf of [REDACTED]—two companies under no threat of litigation. *Id.*, ¶ 4. Petitioner’s reliance on RPX’s marketing material is simply out of place, as it can point to zero evidence that [REDACTED] were motivated by “avoid[ing] litigation costs.” Reply, 24.

G. Petitioner has not shown that the Petition is timely.

Petitioner's outsized focus on the "RPX Agreements" is a red herring. Reply, 28. Privity does not hinge on PO's licenses or relationships with Intel, Sony, or Samsung, but *Petitioner's* relationship with those time-barred parties. PO has presented evidence on this "highly fact-dependent question." *Apps. in Internet Time, LLC v. RPX Corp.*, IPR2015-01750, Paper 128 at 7 (PTAB Oct. 2, 2020) (precedential). By showing that Petitioner manufactured the accused products in the *Intel* litigation, PO produced "evidence to sufficiently put this issue into dispute," and Petitioner can no longer rely on "attorney argument." *Worlds*, 903 F.3d at 1244 n.8, 1246. Petitioner had to provide affidavits, declarations, or other "actual evidence." *Id.* Because Petitioner failed to do this, Petitioner cannot possibly meet its burden.

III. CONCLUSION

For at least the foregoing reasons, the Challenged Claims should be found patentable over the cited references and grounds presented in the IPR proceeding.

Dated: March 28, 2025

Respectfully submitted,

/Alan Whitehurst/

Alan Whitehurst
Reg. No. 43,263
awhitehurst@mckoolsmith.com
Arvind Jairam
Reg. No. 62,759
ajairam@mckoolsmith.com
McKool Smith, P.C.
1717 K St. NW, Suite 1000
Washington, DC 20006
Telephone: (202) 370-8300
Facsimile: (202) 370-8344

Archis "Neil" Ozarkar
Reg. No. 71,265
nozarkar@mckoolsmith.com
McKool Smith, P.C.
600 Travis Street, Suite 600
Houston, TX 77002
Telephone: (713) 485-7300
Facsimile: (713) 485-7344

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. §42.24(d), Petitioner hereby certifies that the word count for the foregoing **PATENT OWNER’S SUR-REPLY** is 5,163 words, which is within the 5,600 word limit set in 37 C.F.R. §42.24(c)(4). This word count does not include the table of contents, table of authorities, exhibit list, certificate of word count, and certificate of service. This word count was prepared using Microsoft Word.

Dated: March 28, 2025

By: /Alan Whitehurst/
Alan Whitehurst, Reg. No. 43,263

CERTIFICATION OF SERVICE

The undersigned hereby certifies that a copy of this **PATENT OWNER'S SUR-REPLY** has been served on Petitioner via email on the following counsel of record for Petitioner:

Miguel Bombach
Bing Ai
John D. Esterhay
John P. Schnurer
Brianna Kadjo
Punkun Jiang
PERKINS COIE LLP
11452 El Camino Real, Ste. 300
San Diego, CA 92130-2080
T: (858) 720-5700

PerkinsServiceMPS-GreenthreadIPR@perkinscoie.com

Dated: March 28, 2025

By: /Alan Whitehurst/
Alan Whitehurst, Reg. No. 43,263