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Paper __
Date: April _, 2026

PUBLIC VERSION

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,
Petitioner,

v.

GREENTHREAD, LLC,
Patent Owner.

IPR2024-00553
Patent 11,316,014 B2

Before KRISTEN L. DROESCH, GRACE KARAFFA OBERMANN, and DONNA M. PRAISS, *Administrative Patent Judges*.

DROESCH, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)
Dismissing Patent Owner's Motion to Exclude
37 C.F.R. § 42.64(c)

I. INTRODUCTION

We have authority to hear this *inter partes* review under 35 U.S.C. § 6, and this Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, Petitioner has established by a preponderance of the evidence that claims 1, 3–9, 13, 15–17, 20, 21, and 23–28 of U.S. Patent No. 11,316,014 B2 (Ex. 1001, "'014 patent") are unpatentable.

A. Background & Procedural History

Monolithic Power Systems, Inc. ("Petitioner" or "MPS") filed a petition requesting *inter partes* review of claims 1, 3–9, 13, 15–17, 20, 21, and 23–28 of the '014 patent. Paper 1 ("Petition" or "Pet."). Greenthread, LLC ("Patent Owner") filed a Preliminary Response. Paper 12 ("Prelim. Resp."). With the Board's authorization, Petitioner filed a Preliminary Reply (Paper 17, "Prelim. Reply"), and Patent Owner filed a Preliminary Sur-reply (Paper 18) to address disputes directed to discretionary denial of institution and privity.

Upon review of the parties' arguments and supporting evidence, we instituted review with respect to all grounds challenging patentability and claims set forth in the Petition. Paper 25 ("Inst. Dec." or "Institution Decision").

Patent Owner filed a Response to the Petition (Paper 33, "PO Resp."), Petitioner filed a Reply to Patent Owner's Response (Paper 37, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 46, "PO Sur-reply").

In support of the Petition, Petitioner relies upon a Declaration of Dr. Stephen Campbell (Ex. 1003). Patent Owner relies upon Declarations of Alexander D. Glew, Ph.D. (Ex. 2057) and Mohan Rao (Ex. 2072) in support

of Patent Owner's Response. In support of the Reply, Petitioner relies on a second Declaration of Dr. Stephen Campbell (Ex. 1054). Dr. Campbell was deposed and Patent Owner filed a transcript of Dr. Campbell's deposition (Ex. 2085).

On April 29, 2025, the one-year statutory period for issuing the final determination in this *inter partes* review was extended for 6 months for good cause. Paper 41.

Patent Owner filed a motion to exclude Exhibit 1059. Paper 55 ("Motion to Exclude" or "Mot. Exclude"). Petitioner filed an opposition to the motion (Paper 56), to which Patent Owner filed a reply (Paper 58).

Related to the remands from Director Review in related proceedings IPR2023-001242, IPR2023-001243, and IPR2023-01244, on June 27, 2025, the Board *sua sponte* ordered discovery and briefing from the parties to address the privity dispute. Paper 57 ("Discovery Order" or "Disc. Order"). Petitioner produced a declaration of Carly Summers (Ex. 2086, "Summers Declaration"). Ms. Summers was deposed and the transcript of Ms. Summers deposition (Ex. 2087) is included in the record.

Patent Owner filed a Supplemental Brief Concerning Board-Ordered Discovery (Paper 64, "PO Privity Br."), Petitioner filed a Responsive Supplemental Brief (Paper 67, "Pet. Resp. Privity Br."), and Patent Owner filed a Supplemental Brief Concerning Board-Ordered Discovery (Paper 68, "PO Reply Privity Br.").

On September 10, 2025, we held an oral hearing. A transcript of the hearing is of record. Paper 76 ("Tr.").

For the reasons that follow, we conclude that Petitioner has established, by a preponderance of the evidence, that challenged claims 1,

3–9, 13, 15–17, 20, 21, and 23–28 of the '014 patent are unpatentable. We also dismiss as moot Patent Owner's Motion to Exclude.

B. Related Matters

The parties indicate that the '014 patent is at issue in the following proceedings: *Greenthread, LLC v. Cirrus Logic, Inc.*, No. 1:23-cv-00369 (W.D. Tex. filed March 31, 2023); *Greenthread, LLC v. Texas Instruments Inc.*, No. 2:23-cv-00157 (E.D. Tex. filed April 6, 2023); *Greenthread, LLC v. OSRAM GmbH*, No. 2:23-cv-00179 (E.D. Tex. filed April 19, 2023); *Greenthread, LLC v. OmniVision Technologies, Inc.*, No. 2:23-cv-00212 (E.D. Tex. filed May 10, 2023); *Greenthread, LLC v. Monolithic Power Systems, Inc.*, No. 1:23-cv-00579 (D. Del. filed May 26, 2023); *Cirrus Logic v. Greenthread, LLC*, IPR2024-00019, filed October 27, 2023; and *Semiconductor Components Industries, LLC d/b/a onsemi v. Greenthread, LLC*, IPR2024-00263, filed December 11, 2023. Pet. 1; Paper 3, 1–2 (Patent Owner's Mandatory Notices).

The parties further indicate that the '014 patent was the subject of numerous additional proceedings. Pet. 2; Paper 3, 2–3.

C. Real Parties in-Interest

Petitioner identifies Monolithic Power Systems, Inc. as the real party in interest. Pet. 1. Patent Owner identifies Greenthread, LLC as the real party-in-interest. Paper 3, 1.

D. The '014 Patent

The '014 patent, titled "Semiconductor Devices with Graded Dopant Regions," issued on April 26, 2022. Ex. 1001, codes (45), (54).

The '014 patent "relates to all semiconductor devices and systems," including Bipolar Junction Transistors (BJT). *Id.* at 1:39–52.

The '014 patent explains that in bipolar junction transistors, minority carriers are the principal device conduction mechanism, but majority carriers also play a small but finite role in modulating the conductivity in such devices. *See* Ex. 1001, 1:50–54. The '014 patent further explains that "[e]fforts have been made in graded base transistors to create an aiding drift field to enhance the diffusing minority carrier's speed from emitter to collector" versus the standard "uniformly doped base" bipolar junction transistors. *Id.* at 1:62–64. The '014 patent explains that this improvement has not been implemented in most semiconductor devices, including various power MOSFETs and IGBTs, which "still use a uniformly doped 'drift epitaxial' region in the base." *Id.* at 1:64–2:2. The '014 patent implements a graded dopant concentration in these devices, which results in at least two important performance enhancements: "electrons can be swept from source to drain rapidly, while at the same time holes can be recombined closer to the n^+ buffer layer," thereby improving "t_{on} and t_{off} in the same device." *Id.* at 3:42–47.

Figure 1 of the '014 patent is reproduced below.

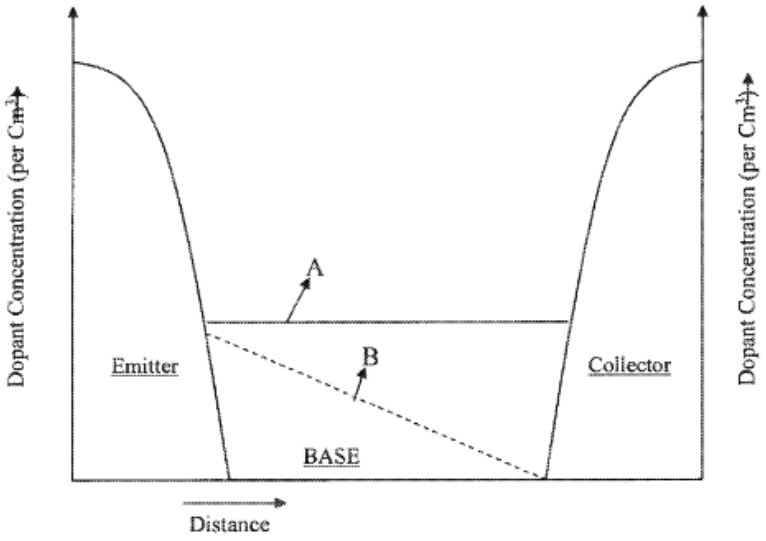


Figure 1 is labeled "Prior Art" and "illustrates the relative doping profiles of emitter, base and collector for the two most popular bipolar junction transistors: namely, uniform base ('A') and graded base ('B')." Ex. 1001, 2:40–43, Fig. 1.

Figure 3A of the '014 patent is reproduced below.

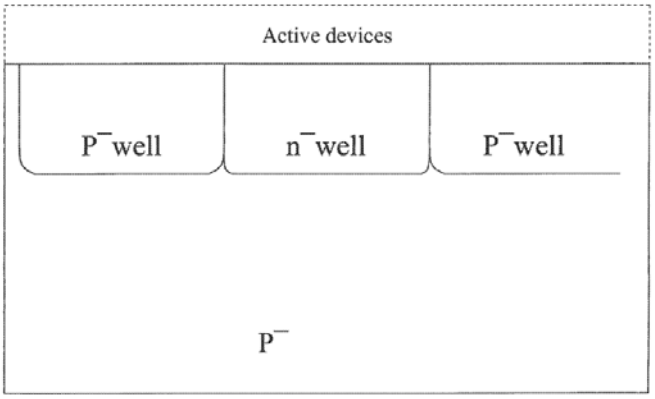


Figure 3A is labeled "Prior art" and shows a cross section of "a typical prior art integrated circuit (IC) with two wells (one n^- well in which p-channel transistors are subsequently fabricated and one p^- well in which n-channel transistors are subsequently fabricated)." Ex. 1001, 2:46–51, Fig. 3A.

Figure 5A of the '014 patent is reproduced below.

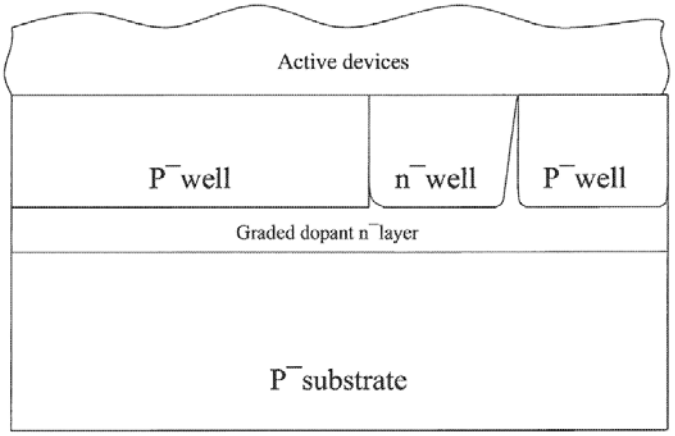


Figure 5A illustrates a cross section of a CMOS silicon substrate with two wells and an underlying layer using embodiments of the invention. *See* Ex. 1001, 2:58–61. According to the '014 patent, "[s]purious minority carriers can be generated by clock switching in digital VLSI logic and memory ICs." *Id.* at 3:48–52. The '014 patent states that these "unwanted carriers can discharge dynamically-held 'actively held high' nodes," and serve to degrade performance of various types of devices, including digital imaging ICs. *Id.* at 3:51–59. According to the '014 patent, "a novel technique is described" in which "a drift field [is used] to sweep these unwanted minority carriers from the active circuitry at the surface into the substrate in a monolithic die as quickly as possible." *Id.* at 3:64–4:1. For example, "[i]n a preferred embodiment, the subterranean n^- layer has a graded donor concentration to sweep the minority carriers deep into the substrate." *Id.* at 4:1–3.

Figure 5B is reproduced below.

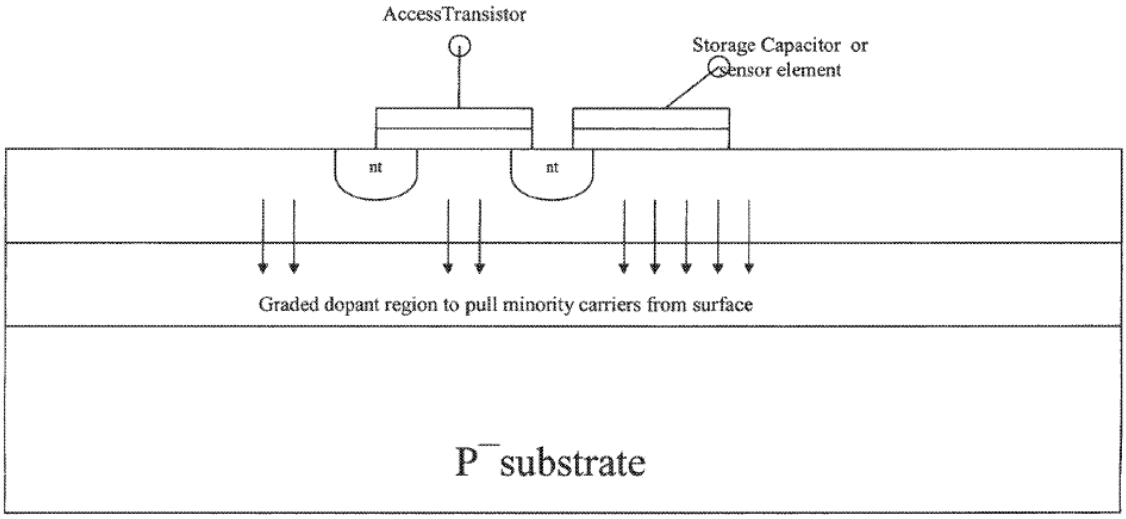


Figure 5B depicts n-type wells in a P-type substrate and includes arrows facing downwards towards the P-type substrate and a label: "Graded dopant region to pull minority carriers from the surface." Ex. 1001, Fig. 5B.

E. Illustrative Claim

Claims 1 and 21 are independent, with claims 3–9, 13, 15–17, and 20 dependent from claim 1, and claims 23–28 dependent from claim 21. Ex. 1001, 4:49–6:56. Claim 1 is illustrative of the challenged claims and is reproduced below.

> 1. An electronic system, the system comprising:
> at least one semiconductor device, the at least one semiconductor device including:
> a substrate of a first doping type at a first doping level having a surface;
> a first active region disposed adjacent the surface with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
> a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
> transistors formed in at least one of the first active region or second active region;

> at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions; and
>
> at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface towards the area of the substrate where there are no active regions, wherein at least some of the transistors form digital logic of the semiconductor device.

Id. at 4:49–5:7.

F. Patentability Challenges and Asserted Prior Art

Petitioner asserts that claims 1, 3–9, 13, 15–17, 20, 21, and 23–28 would have been unpatentable based on following grounds (Pet. 10):

Claims Challenged	35 U.S.C. §[1]	Reference(s)/Basis
1, 3–9, 13, 15–17, 20, 21, 23–28	103(a)	Kawagoe[2]
1, 3–9, 13, 15–17, 20, 21, 23–28	103(a)	Onoda[3]
1, 3–9, 13, 15–17, 20, 21, 23–28	103(a)	Onoda, Nishizawa[4]

[1] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the '014 patent has an effective filing date before that date, we refer to the pre-AIA version of § 103. Ex. 1001, code (60).

[2] U.S. Patent No. 6,043,114, issued Mar. 28, 2000 (Ex. 1007, "Kawagoe").

[3] Japanese Unexamined Patent Application Publication No. H8-279598, published Oct. 22, 1996 (Ex. 1043, "Onoda"). A certified translation, to which we cite, is provided. Ex. 1042.

[4] U.S. Patent No. 5,384,476, issued January 24, 1995 (Ex. 1046, "Nishizawa").

II. PRIVITY – TIMELINESS OF PETITION UNDER 35 U.S.C. § 315(b)

Pursuant to 35 U.S.C. § 315(b), "[a]n inter partes review may not be instituted if the petition requesting the proceeding is filed more than 1 year after the date on which the petitioner, real party in interest, or privy of the petitioner is served with a complaint alleging infringement of the patent." The question of whether Petitioner is time-barred under § 315(b) is part of the determination of whether to institute an *inter partes* review. *See Thryv, Inc. v. Click-to-Call Techs., LP*, 590 U.S. 45, 54 (2020) ("§ 315(b) expressly governs institution and nothing more"). We explain below why we address this issue of timeliness at this juncture.

Patent Owner argues that the Petition should be dismissed because it is untimely on the basis that Petitioner is in privity with Intel Corp. ("Intel"), and [redacted] who Patent Owner asserts are time-barred under 35 U.S.C. § 315(b) and licensed under the '014 patent. *See* PO Resp. 35–59. Prior to institution, Patent Owner's arguments regarding privity were based on several theories, including that Petitioner and the Licensees "are 'preceding and succeeding owners of' licensed (or infringing) products," that Petitioner is a beneficiary of the Licensees' agreements related to accused products, that Petitioner's licensed sales encumber otherwise infringing articles, that Petitioner apparently indemnify the time-barred parties for custom-made products, and that Petitioner serves as an agent of Licensees by exercising their "have made" rights under the license. *See* Prelim. Resp. 24, 32–37.

In the Institution Decision, the Board determined that Patent Owner had not provided a sufficient factual basis upon which to question Petitioner's representation that it is not time barred, or that Petitioner and [redacted] Intel, or [redacted] were, in fact, privies, based on any of its theories

regarding privity. *See* Inst. Dec. 16–25. We incorporate that analysis here, and reconsider Patent Owner's contentions to the extent it is warranted by subsequent, argument and evidence. *See id.*; *Achates Reference Publ'g. Inc. v. Apple Inc.*, 803 F.3d 652, 658 (Fed. Cir. 2015) ("The Board's reconsideration of the time-bar [in the final determination] is 'still fair[ly] characterize[ed] as part of the decision to institute.'") (second and third alterations in original).

Subsequent to the Institution Decision, Patent Owner asserts that (1) control of prior litigation is not required to establish privity (*see* PO Resp. 39–42); (2) even though Petitioner bears the burden to show that its petition was timely, i.e., that Petitioner is not in privity with [redacted] Intel, or [redacted] Petitioner has not attempted to carry its burden (*see id.* at 42–46); (3) evidence of record shows that the petition is time-barred (*see id.* at 48–55); and (4) a finding in Petitioner's favor would violate Patent Owner's constitutional right to due process (*see id.* at 55–59). We address these arguments below.

Patent Owner's argument regarding violation of its constitutional right to due process is based on denial of its opportunity to show that Petitioner's assertions as to its relationships with Licensees are untrue or incomplete, but this issue is now moot. *See* PO Resp. 57–59. The Board subsequently ordered additional discovery concerning privity as discussed below. We address Patent Owner's remaining privity arguments below.

On February 11, 2025, the Board entered Final Written Decisions in certain related Greenthread proceedings. IPR2023-01242, Paper 84; IPR2023-01243, Paper 82; IPR2023-01244, Paper 83 (collectively referred to as "first wave" cases). Patent Owner sought Director Review of these decisions, and on April 24, 2025, Patent Owner's Requests for Director

Review were granted, and the Final Written Decisions were vacated and remanded to the Board for further proceedings. IPR2023-01242, Paper 94; IPR2023-01243, Paper 91; IPR2023-01244, Paper 91 ("Director Review Order" or "Dir. Rev. Order").

The Director Review Order remands "to the Board with instructions to allow discovery, narrowly tailored to [a] privity issue" relating to an alleged relationship between Petitioner and a non-party, Intel. Dir. Rev. Order 3. In particular, the Director Review Order provides the following instructions:

> The Board should then determine on the full record whether Petitioner has met its burden of demonstrating it is not time-barred under § 315(b); that is, whether Patent Owner has produced some evidence to support its argument that Intel should be named as a privy so as to have put the issue into dispute.

Id. (citing *Worlds Inc. v. Bungie, Inc.*, 903 F.3d 1237, 1242–44 (Fed. Cir. 2018)). As the same privity issue arises in the present proceeding, we also follow the guidance of the Director Review Order here as well.

On May 8, 2025, the Board held a teleconference with the parties to discuss the impact of the Director Review Order on various Greenthread proceedings, including this one. *See* Paper 44, 2. During the teleconference, the Board inquired as to whether Patent Owner would request additional discovery in this case pursuant to the Director Review Order. *Id.* Patent Owner indicated that it believes the Board made a legal error in its Institution Decision by failing to shift the burden of production to Petitioner with regard to the issue of privity. *Id.* at 3. As such, Patent Owner did not request additional discovery and indicated that, instead, it would "rest on its papers." *Id.*; *see also* Disc. Order 4.

Subsequently, in this proceeding (as well as in IPR2024-00468, IPR2024-00469, IPR2024-00470, IPR2024-00550, IPR2024-00551, and

IPR2024-00552), the Board *sua sponte* issued a Discovery Order (Paper 57) "narrowly tailored," consistent with the Director Review Order, ordering Petitioner to provide the following discovery to Patent Owner:

> (a) . . . documents [including]:
>
> > [i. s]ales agreements between Petitioner and Intel for the Intel Accused Products;[5] and
> >
> > [ii. i]ndemnification agreements between Petitioner and Intel for the Intel Accused Products. *See* [IPR2023-001242, Paper 94, 3].
>
> (b) Documents sufficient to show the asserted privity relationship between Petitioner and Intel, including any new declaration(s) that establish that no documents responsive to Subsection (a) above exist, as well as any documents and new declaration(s) that establish (1) the time by which Petitioner became aware of the Intel litigation referenced in the Director's Decision; (2) whether Petitioner was the supplier of any product, or component of a product, accused of infringement in the Intel litigation; and (3) whether Petitioner was in a position to control, or actually controlled, Intel's defense of that litigation.

Disc. Order 6–7.

In response to the Board's Discovery Order, Petitioner produced and Patent Owner filed a Declaration of Carly Summers (Ex. 2086). Ms. Summers was deposed and the transcript of Ms. Summers deposition (Ex. 2087) is included in the record. The parties also filed briefing to address the ordered discovery and the privity dispute. *See* PO Privity Br.; Pet. Resp. Privity Br.; PO Reply Privity Br. The parties subsequently agreed

[5] The "products accused" consist of the "Intel Accused Products" listed on pages 4–8 of Exhibit 2021, namely, the Intel "products accused of practicing the challenges claims in Patent Owner's prior litigation.

that oral argument held on September 10, 2025, would cover all relevant issues including the privity dispute, and that there need not be a separate telephonic hearing on privity. Paper 69.

Having considered the evidence of record, we determine that Petitioner is not in privity with Intel, and the Petition is not time-barred under 35 U.S.C. § 315(b).

The briefs comingle analyses of the issues of real party in interest (RPI) and privity, and often use the terms interchangeably. *See, e.g.*, PO Privity Br. 1–2; PO Reply Privity Br. 2. The two terms, however, describe distinct concepts with differing effects under the statute. *See, e.g.*, 35 U.S.C. § 312(a)(2) (petition must identify all RPIs, but not privies). Prior to analyzing the parties' arguments, we summarize the concept of privity below.

A. Statutory Bar as Nonparty Preclusion

The one-year statutory bar of § 315(b) "helps to ensure that *inter partes* review provides a quick and cost-effective alternative to litigation, and is not used as a tool for harassment or litigation gamesmanship." *Johnson Health Tech. Co. v. Icon Health & Fitness, Inc.*, IPR2014-01242, Paper 16 at 3 (PTAB Feb. 11, 2015) (citing H.R. REP. NO. 112-98 at 48, *as reprinted in* 2011 U.S.C.C.A.N. at 78). In this sense, § 315(b) is analogous to the common-law doctrines of claim preclusion and issue preclusion, which "preclude parties from contesting matters that they have had a full and fair opportunity to litigate," thereby "protect[ing] their adversaries from the expense and vexation attending multiple lawsuits, conserv[ing] judicial resources, and foster[ing] reliance on judicial action by minimizing the possibility of inconsistent decisions." *Montana v. United States*, 440 U.S. 147, 153–54 (1979). Our Practice Guide, therefore, looks to these doctrines

of preclusion in interpreting the language of § 315(b). *See* Patent Trial and Appeal Board Consolidated Trial Practice Guide (Nov. 2019) ("CTPG")[6] at I.D.1.

Like the common-law preclusion doctrines, the preclusive effect of § 315(b) also extends beyond those who were parties to the prior lawsuit. Because nonparty preclusion risks binding those who have not had a full and fair opportunity to litigate, the Supreme Court has cautioned that there is a general rule against nonparty preclusion, subject only to limited exceptions. *See Taylor v. Sturgell*, 553 U.S. 880, 892–93 (2008). In *Taylor*, while noting that it was not a "definitive taxonomy" (*id.* at 893 n.6), the Court set forth a list of six "categories" under which nonparty preclusion may apply.[7]

> (1) "[A] person who *agrees to be bound* by the determination of issues in an action between others is bound in accordance with the terms of his agreement." *Id.* at 893.
>
> (2) "[N]onparty preclusion may be justified based on a variety of *'pre-existing substantive legal relationship[s]'* between the person to be bound and a party to the judgment," such as "preceding and succeeding owners of property, bailee and bailor, and assignee and assignor." *Id.* at 894.
>
> (3) "[I]n certain limited circumstances," such as class actions, "a nonparty may be bound by a judgment because she was *'adequately represented* by someone with the same interests who [wa]s a party to the suit.'" *Id.* The Court later elaborated that this exception applies only if there are "special procedures to protect the nonparties' interests or an understanding by the concerned parties that the first suit was brought in a representative capacity." *Id.* at 897.

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[6] Available at www.uspto.gov/patents/ptab/trial-practice-guide.

[7] For clarity, we omit some internal quotation marks and citations throughout the list of categories enumerated in *Taylor*, and add emphasis on certain key phrases, and provide generally cleaned up quotations.

> (4) "[A] nonparty is bound by a judgment if she '*assumed control*' over the litigation," because that person "has had 'the opportunity to present proofs and argument' . . . even though he was not a formal party to the litigation." *Id.* at 895 (emphasis added).
>
> (5) "[A] party bound by a judgment may not avoid its preclusive force by *relitigating through a proxy*," such as "when a nonparty later brings suit as an agent for a party who is bound by a judgment." *Id.*
>
> (6) "[A] *special statutory scheme*," such as bankruptcy or probate proceedings, "may 'expressly foreclose successive litigation by nonlitigants . . . if the scheme is otherwise consistent with due process.'" *Id.*

Having listed these categories, the Court then held that a broader doctrine of nonparty preclusion, termed "virtual representation," was inconsistent with Federal common law, and risked violating due process. *Id.* at 898–900. Therefore, nonparty preclusion cannot be based on mere "identity of interests and some kind of relationship between parties and nonparties." *Id.* at 901.

B. Overview of Privity

"[T]he mere existence of some relationship between a petitioner and another entity is not sufficient" to place that petitioner in privity with that entity. *Google LLC v. DDC Technology, LLC*, IPR2023-00707, Paper 27 at 37 (PTAB Oct. 25, 2023). Instead, "that relationship must be related to [an earlier] lawsuit and be sufficiently close that it can be fairly said *the petitioner had a full and fair opportunity to litigate the validity of the patent in that lawsuit*." *Id.* (emphasis added). In other words, privity concerns "whether the petitioner and the prior litigant's relationship—as it relates to the [earlier] lawsuit—is sufficiently close that it can be fairly said that the petitioner had a full and fair opportunity to litigate the validity of the patent in that lawsuit," or "whether the petitioner is simply serving as a proxy to

allow another party to litigate the patent validity question that the other party raised in an earlier-filed litigation." *WesternGeco LLC v. ION Geophysical Corp.*, 889 F.3d 1308, 1319 (Fed. Cir. 2018).

Though expansive, the concept of privity has boundaries set by due process. As the Court held in *Taylor*, extending the preclusive concept of privity to those in "virtual representation," through identity of interest and a determination that the relationship of the parties is "'close enough' to bring the second litigant within the judgment," is impermissible. *See Taylor*, 553 U.S. at 898. Only if the nonparty can be said to have had a "full and fair opportunity to litigate" can that nonparty be precluded as a privy. *Id.* at 892–93; *see also Aspex Eyewear, Inc. v. Zenni Optical, Inc.*, 713 F.3d 1377, 1382 (Fed. Cir. 2013) ("[a] full and fair opportunity to litigate is the touchstone of any preclusion analysis.").

Courts examine different aspects of the parties' relationship, depending on the issue for which privity is being asserted. *See Int'l Nutrition Co. v. Horphag Research, Ltd.*, 220 F.3d 1325, 1329 (Fed. Cir. 2000) ("[a] variety of relationships between two parties can give rise to the conclusion that a nonparty to an action is 'in privity' with a party to the action"). For example, the parties' contractual relationship (privity of contract) regarding a product is relevant when determining whether an injunction against the sale of that product applies. *See In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litigation*, 504 F. App'x 900, 906 (Fed. Cir. 2013) (unpublished). In other situations—for example, in the case of a judgment with respect to a particular property interest—the relationship between the parties with respect to the transfer of the property may be the focus. *See Int'l Nutrition*,

220 F.3d at 1329. Therefore, the same two parties may be in privity for certain purposes, but not for others. *Id.*

In the context of § 315(b), the goal of the preclusion is to prevent successive challenges to a patent by those who previously have had the opportunity to make such challenges in prior litigation. As such, the focus of our privity inquiry is on the relationship between the parties *during the prior lawsuit*. In other words, we ask whether the instant petitioner and the prior litigant's relationship—as it relates to the lawsuit—is sufficiently close that it can be fairly said that the petitioner has had a full and fair opportunity to litigate the validity of the patent in the lawsuit. *See Aruze Gaming Macau, Ltd. v. MGT Gaming, Inc.*, IPR2014-01288, Paper 13 at 14 (PTAB Feb. 20, 2015).

In this sense, our privity inquiry will typically fall into *Taylor*'s fourth category of nonparty preclusion, which applies to situations in which the petitioner "has had 'the opportunity to present proofs and argument'" such that it can be said to have "assumed control" over the action. *Taylor*, 553 U.S. at 895 (brackets omitted). Our Practice Guide reflects this, noting that control is a "common consideration" in the privity inquiry. CTPG at I.D.1.

Furthermore, we note that *actual* assumption of control of the lawsuit is not necessary for a finding of privity; the opportunity, or legal right, to assume control is sufficient. "Substantial control . . . connotes the availability of a significant degree of effective control in the prosecution or defense of the case—what one might term, in the vernacular, the power—whether exercised or not—to call the shots." *Gonzalez v. Banco Central Corp.*, 27 F.3d 751, 758 (1st Cir. 1994); *see Arris Group, Inc. v. C-Cation Techs., LLC*, IPR2014-00746, Paper 22 at 10 (PTAB Nov. 24, 2014) (inquiring into whether party exercised, or could have exercised,

control over District Court action); *see also* CTPG at I.D.1 (quoting 18A Charles Alan Wright, Arthur R. Miller & Edward H. Cooper, Federal Practice & Procedure § 4451 (2d ed. 2011)) ("control generally means that 'it should be enough that the nonparty has the actual measure of control or *opportunity to control* that might reasonably be expected between two formal coparties'") (emphasis added).

Finally, privity is based on "flexible and equitable considerations," and, therefore, neither the Practice Guide nor our decisions set any bright-line test for when privity exists. CTPG at I.D.1. Nor should the preceding discussion be understood to mandate that all § 315(b) privity relationships fall within the fourth "assumed control" category set forth in *Taylor*. Common to our cases, however, is a focus on the relationship between the parties in the context of the prior lawsuit, and an inquiry as to whether the petitioner's relationship with the prior litigant was sufficiently close that it can be said that the petitioner had, or will have, a full and fair opportunity to litigate the validity of the patent in that prior action. If we are satisfied that petitioner has "enjoyed its day in court" through its relationship with the litigant, it is fair to consider the parties to be privies. *See Gonzalez*, 27 F.3d at 758.

In *Taylor*, the Court held that

> a party bound by a judgment may not avoid its preclusive force by relitigating through a proxy. Preclusion is thus in order when a person who did not participate in a litigation later brings suit as the designated representative of a person who was a party to the prior adjudication . . . [I]t also seems clear that preclusion is appropriate when a nonparty later brings suit as an agent for a party who is bound by a judgment.

Taylor, 553 U.S. at 895.

C. Petitioner's Arguments

Petitioner contends that "[t]here is no privity between Petitioner and Intel." Pet. Resp. Privity Br. 15. According to Petitioner, "even if Petitioner had known about and wanted to control the Intel litigation, it could not have because Petitioner has no contractual agreements with Intel that would give it the right of such control." *Id.* at 9 (citing Ex. 2086 ¶¶ 6, 7); *see id.* at 1 (arguing that Petitioner established that it has no sales or indemnity agreements with Intel), 5–6 (reproducing portions of Ex. 2086 ¶¶ 6–8, 10, 12). Petitioner asserts that "[t]he legal relationship factors also weigh heavily against privity because Petitioner does not have any indemnity or sales agreements with Intel and is not the supplier to Intel for any product or component which was accused in the Intel litigation." *Id.* at 10; *see id.* (citing Ex. 2086 ¶¶ 6–8; Ex. 2087, 35:1–4).

Petitioner contends that

> in *WesternGeco*, the Federal Circuit affirmed that no privity existed even when there was an indemnification clause in a sales agreement because the clause did not specify the meaning of "'indemnify' as requiring [the party] . . . to pay for any litigation defense expenses or for any damages related to infringement." 889 F.3d at 1321. If no privity exists even when an indemnification clause and sales agreement exist, then certainly, no indemnification or sales agreements push the present situation further away from a finding of privity.

Pet. Resp. Privity Br. 11 (citing *WesternGeco*, 889 F.3d at 1321) (alterations by Petitioner). Petitioner clarifies that its Declarant, Ms. Carly Summers, "did not merely look for sales and indemnity agreements just for the Intel Accused products ('IAPs'), but instead investigated if Petitioner had *any* sales or indemnity agreements with Intel." *Id.* at 12 (citing PO Privity Br. 5–6; Ex. 2086 ¶¶ 6, 7). Petitioner asserts that, because its "products

were not implicated in the Intel lawsuit," "Petitioner would have had no grounds to step in even if there was such an obligation." *Id.* at 10.

Petitioner's Declarant Ms. Summers testified that "Petitioner first learned of Patent Owner's litigation against Intel on or about May 26, 2023," (Ex. 2086 ¶ 10) and, according to Petitioner, "which was a month *after* the Intel case settled (and was after Intel's own one-year time bar had already run)" (Pet. Resp. Privity Br. 9). Thus, according to Petitioner, "[t]he control factor weighs against privity because Petitioner did not control or direct the lawsuit between Patent Owner and Intel." *Id.* Ms. Summers also testified that "Petitioner had no knowledge of, or involvement in, Intel's defense in its litigation against Patent Owner. Petitioner did not actually control, nor was it in a position to control, Intel's defense in that litigation." Ex. 2086 ¶ 12; Pet. Resp. Privity Br. 9. According to Petitioner, "[i]t is common sense," that "Petitioner could not have controlled the Intel case when it did not even know it was happening." Pet. Resp. Privity Br. 10. Petitioner further contends that "there is 'no evidence to suggest that [Petitioner] . . . directed, funded, controlled, or influenced' the Intel case." *Id.* (quoting *WesternGeco*, 889 F.3d at 1320).

D. Patent Owner's Arguments

Patent Owner argues that it "has presented far more than 'some evidence' that time-barred parties, including Intel[], should have been named as RPI in the Petition." PO Privity Br. 2 (internal footnote omitted). In a footnote, Patent Owner further asserts that it "maintains that Petitioners are in privity with both [redacted] and [redacted] two other time-barred parties," and "that discovery should have been granted as to these parties for at least the reasons

presented in the Joint Paper Concerning Additional Discovery in the Wave 1 (*onsemi*) IPRs." *Id.* at 2 n.2 (citing IPR2023-01242, Paper 108 at 2–5).

Patent Owner argues that its evidence confirms that MPS is a component supplier to Intel and "[a]s a result, Petitioner received a sublicense as a 'have made vendor' to make and sell products to Intel under Intel's license with [Patent Owner]." PO Privity Br. 2–3 (citing Prelim. Reply 5; Exs. 2017–2019; Ex. 2011, 3). According to Patent Owner, Petitioner's Declarant Ms. Summers "testified that 'MPS sells some custom products,'" and "confirmed [Patent Owner]'s longstanding belief that Petitioner's sales 'contract include an indemnity clause against patent infringement.'" *Id.* at 3 (quoting Ex. 2087, 31:11–15, 34:11–17). Patent Owner also contends that it "has previously submitted evidence that Petitioner 'maintains a staff of applications engineers who work directly with [] customer' engineers.'" *Id.* (quoting Ex. 2022, 6) (alteration by Patent Owner).

Patent Owner contends that the position of Petitioner's Declarant Ms. Summer "is undermined by two critical admissions: Petitioner is a ***component*** supplier and has an ***indirect*** sales model." PO Privity Br. 6. According to Patent Owner, "[a]s a result, she failed to present to the Board a comprehensive account of Petitioner's relationship with Intel under the guise of conducting a complete and thorough 'investigation.'" *Id.* Patent Owner argues that Ms. Summers did not investigate *indirect* sales of parts or components to Intel, nor did she consult with the parties or people who would possess relevant information. *See id.* at 6–13; *see also id.* at 7 (quoting Ex. 2087, 16:21–17:2). In particular, Patent Owner argues that "Ms. Summers testified that she did not know whether *any* MPS components are included in *any* Intel devices and, as discussed in more detail below, she

did not avail herself of any opportunity to learn the answer to that question." *Id.* at 9. Patent Owner also takes the position that "Ms. Summers clearly admitted that she does not 'know whether the Intel Core i5-12400 processor'—or any of the other processors included in the list of IAPs—'includes any element designed or manufactured' by MPS." *Id.* (citing Ex. 2087, 25:5–26:2).

Patent Owner argues that "[n]ot only does Ms. Summer's conclusory declaration fail to satisfy the [Discovery] Order, but Petitioner offered no accompanying documents to substantiate the claims made by its declarant." PO Privity Br. 13. According to Patent Owner,

> Ms. Summers testified about numerous issues where, presumably, she would have come across pre-existing documents or would have generated documents as part of the investigation. For example, she described how she "searched" for all sales and indemnification agreements concerning the IAPs, but did not attach any computer printouts or other documents confirming that no such agreements existed. Relatedly, she mentioned searching her own files, emails, and those of "every employee in Petitioner's legal department," and instructed the "IT department [to] search the archived files and e-mails of . . . former employees." Ms. Summers provided no proof whatsoever to corroborate her declaration.

Id. at 14 (citing Ex. 2086[8] ¶¶ 6, 7, 9).

E. Analysis

Our analysis below concerns whether Petitioner is in privity with Intel. *See* Dir. Rev. Order. *Worlds* is a seminal case that addresses burdens on the parties when § 315 is at issue. *Worlds*, 903 F.3d 1237. In *Worlds*, the Court held that "an IPR petitioner's initial identification of the real parties in

[8] Patent Owner erroneously cites Ex. 2087 instead of Ex. 2086.

interest should be accepted unless and until disputed by a patent owner." *Id.* at 1242. The Court also "agree[d] that a patent owner must produce *some evidence* to support its argument that a particular third party should be named a real party in interest." *Id.* (emphasis added). "[T]here can be no doubt that the IPR petitioner bears the ultimate burden of persuasion to show that its petitions are not time-barred under§ 315(b) based on a complaint served on an alleged real party in interest more than a year earlier." *Id.* Although *Worlds* addressed RPI, it more broadly discussed § 315 in general, which covers both RPI and privity.

In this proceeding, Patent Owner did not produce "some evidence" tending to show that Petitioner is in privity with Intel and the burden never shifted to Petitioner. Even if Patent Owner produced evidence sufficient to put the relationship between Petitioner and Intel into dispute, the evidence adduced during trial sufficiently supports Petitioner's position and, in particular, satisfies Petitioner's burden to show it is not time-barred under § 315(b).

The evidence adduced during trial does not support a finding that the relationship between Petitioner and Intel is sufficiently close that both should be bound by the trial outcome and related estoppels, nor does it suggest, without more, that the parties were litigating either the district court action or the IPRs as proxies for the other. In a nutshell, the record is devoid of evidence tending to show that Petitioner controlled, or had an opportunity to control, the Intel litigation. To the contrary, as explained below, the only record evidence on point supports Petitioner's position that it did not control, or have any opportunity to control, the Intel litigation.

Petitioner contends that it had no knowledge of the Intel litigation "until after that lawsuit had concluded," "its components were not

implicated in the Intel litigation," and "it did not participate in, control, or have an opportunity to control, the Intel litigation in any way." Pet. Resp. Privity Br. 1. According to Ms. Summers, Petitioner "first learned of Patent Owner's litigation against Intel on or about May 26, 2023," "as it began to investigate the allegations in, and merits of, Patent Owner's May 26, 2023 complaint against Petitioner." Ex. 2086 ¶ 10. Ms. Summers also testified that "Petitioner had no knowledge of, or involvement in, Intel's defense in its litigation against Patent Owner" and "did not actually control, nor was it in a position to control, Intel's defense in that litigation." *Id*. ¶ 12.

In light of the assertions of lack of *actual* participation in and control of, or opportunity to control, the Intel litigation by Petitioner, and the lack of evidence as to whether Intel controlled or had an opportunity to control Petitioner's decisions in the Petitioner-initiated IPRs[9], we next consider Petitioner's and Intel's relationship, as it relates to the Intel litigation. We consider whether that relationship is sufficiently close such that the Intel litigation would have given Petitioner a full and fair opportunity to litigate the validity of the challenged claims of the '014 patent or whether Petitioner is "simply serving as a proxy to allow" Intel "to litigate the patent validity question that" Intel "raised in an earlier filed litigation." *See WesternGeco*, 889 F.3d at 1320 ("[T]he privity analysis is broader than simply inquiring whether PGS controlled or had an opportunity to control ION's decisions in the ION patent infringement litigation, or whether ION controlled or had an opportunity to control PGS's decisions in the PGS-initiated IPRs.").

In response to the Board's Discovery Order, Petitioner produced evidence, none of which supports Patent Owner's argument that Intel should

[9] Patent Owner does not assert that Intel is an RPI to the present proceeding.

be named as a privy. *See* Dir. Rev. Order 3. It is worth emphasizing here that, contrary to Patent Owner's position (*see, e.g.*, PO Privity Br. 2), the Director did not indicate that Patent Owner had met is burden of production under the *Worlds* decision. *See* Dir. Rev. Order 3. To the contrary, the Director remanded to the Board to allow discovery to determine, on the full record, "*whether* Patent Owner has produced some evidence to support its argument that Intel should be named as a privy *so as to have put the issue into dispute*." *Id.* (emphasis added) (citing *Worlds*, 903 F.3d at 1242–44).

We are not persuaded that Petitioner is in privity with Intel because the evidence of record supports the following findings: "(1) [Petitioner] has no sales or indemnity agreements with Intel, (2) it does not supply any products to Intel, (3) it had no knowledge of [the Intel litigation] until after that lawsuit had concluded, (4) its components were not implicated in the Intel litigation, and (5) it did not participate in, control, or have an opportunity to control, the Intel litigation in any way." Pet. Resp. Privity Br. 1.

Notwithstanding Patent Owner's arguments, addressed below, we find persuasive Petitioner's Declarant Ms. Summers' testimony that Petitioner lacks any connection to the Intel Accused Products. Specifically, Ms. Summers has been Senior Corporate Counsel at MPS since August 2021, and her responsibilities include "leading the negotiation, drafting, and preparation of commercial contracts, including vendor, licensing, and supply agreements" and "support[ing] Petitioner's Supply Chain and Sales team functions, including identifying legal risks and proposing strategies to safeguard Petitioner's interests." Ex. 2086 ¶¶ 1, 3. We are persuaded that Ms. Summers' experience supports that she had sufficient knowledge to attest to her testimony that "Petitioner's principal customers are contract

manufacturers located in Asia, rather than downstream branded companies such as Intel," "Petitioner did not sell to Intel, or supply Intel with, any of the Intel Accused Products," and "Petitioner was not the supplier to Intel of any product, or component of a product, accused of infringement in the Intel litigation." *Id.* ¶ 8.

Petitioner persuasively contends that Patent Owner's attack against Ms. Summers "for not knowing whether Petitioner's products could somehow, through some unknown, hypothetical chain of third-party transactions, wind up in an [Intel Accused Product (IAP)]" is "irrelevant to the privity analysis" as "Patent Owner does not cite a case showing that a party's product which was not implicated as an accused product in another lawsuit was a dispositive factor for finding privity." Pet. Resp. Privity Br. 13 (citing PO Privity Br. 10–13); *see also id.* ("[D]espite having years to investigate [the IAPs], Patent Owner has never claimed, much less produced ***any*** evidence, that ***any*** of the IAPs contains ***any*** of Petitioner's products."). Petitioner also persuasively contends that in response to Patent Owner's attack of Declarant Summers "for not investigating whether there were indirect sales from Petitioner to Intel," "offering a product that some unknown downstream customer, through some unknown string of transactions, might ultimately supply to Intel, cannot serve as the basis for finding privity." *Id.* at 13–14 (citing PO Privity Br. 4–10). Petitioner persuasively argues that "even if Patent Owner had produced evidence that any of Petitioner's products ***were*** in any of the IAPs, that fact would carry little weight in the privity analysis and would certainly not outweigh the predominant factors—control, indemnity and sales agreements, and fairness—which weigh heavily against a finding of privity," especially considering the unrebutted assertion that "[t]he IAPs were Intel-fabricated

microprocessors, not low-level components such as Petitioner's tiny power converters and regulators." *Id.* at 15 (citing Ex. 2009 ¶ 65; Ex. 2005; Pet. Reply 26).

We see no issue as to Petitioner's inability to provide sales agreements or other documents that would prove a negative—that Petitioner did not sell the IAPs or components thereof to Intel. Patent Owner alleges that Petitioner's Declarant Carly Summers limited her investigation to a subset of the issues highlighted in the Board's Order and did not investigate indirect sales of parts or components to Intel. PO Privity Br. 6–10. According to Patent Owner, for example, Declarant "Summers clearly admitted that she does not 'know whether the Intel Core i5-12400 processor'—or any of the other processors included in the list of IAPs—'includes any element designed or manufactured' by MPS" and "[s]he has never 'seen a parts list for any of these processors,' and did not know whether 'anyone [else] in-house' had either." *Id.* at 9 (citing Ex. 2087, 25:5–26:2, 26:8–13). This is beyond the scope of the Board's Discovery Order, which required sales and indemnifications agreements "*between* Petitioner and *Intel* for the Intel Accused Products," "as well as any documents and new declaration(s) that establish . . . whether Petitioner was the supplier of *any product, or component of product, accused of infringement in the Intel litigation*." Disc. Order 6–7 (emphasis added). The Discovery Order did not specifically require Petitioner to adduce evidence concerning whether Petitioner supplied products or components to Intel for use in or with other Intel products not accused in the Intel Litigation.

Indirect Sales and Third-Party Resellers

Patent Owner takes the position that Petitioner's Declarant Ms. Summers' investigations included insufficient efforts to learn whether any of its parts or products are or were, in any way, incorporated into Intel processors in post-transfer, downstream transactions because "Ms. Summers never consulted with the sales or engineering teams at MPS to determine the extent of Petitioner's relationship with Intel," and did not "'reach out to anyone in sales or engineering to find out whether or not MPS components are included in Intel devices.'" PO Privity Br. 12 (quoting Ex. 2087, 19:10–20:2). The Discovery Order did not specifically require Petitioner to produce evidence beyond agreements between Petitioner and Intel related to products accused of practicing the challenged claims. Disc. Order 6–7. Here again, we observe that the Discovery Order comports with the Director's mandate for us to investigate and resolve whether "Petitioner was a supplier of" products that were "accused of practicing the challenged claims" in the Intel litigation. Dir. Rev. Order 3. Stated differently, the Discovery Order did not require Petitioner to produce evidence of any *indirect* sales of its components or products to Intel that occurred after Petitioner surrendered control of the items. Disc. Order 6–7. Such evidence, in any case, would be insufficient to establish privity between Petitioner and Intel based on control of, or an opportunity to control, the relevant litigation.

According to Patent Owner, Petitioner's Declarant "Ms. Summers confirmed [Patent Owner]'s longstanding belief that Petitioner's sales 'contract include an indemnity clause against patent infringement.'" PO Privity Br. 3 (citing Ex. 2087, 31:11–15). Regardless of whether the general nature of Petitioner's contracts include an indemnity clause,

Ms. Summers' testimony persuasively "confirm[s] that . . . '[t]here are no indemnification agreements at all ***between Petitioner and Intel***.'" Pet. Resp. Privity Br. 10 (citing Ex. 2086 ¶ 7) (emphasis added).

Incorporation of Petitioner's Products into Non-Accused Intel Products

To the extent Patent Owner argues that Petitioner's investigation is lacking for failure to determine any potential use of Petitioner's products in *non-accused* Intel products (*see, e.g.*, PO Privity Br. 2–3), this argument is unavailing. A "manufacturer-customer relationship alone does not establish privity" at least because any such relationship does not concern supplying *IAPs or components thereof*. *See WesternGeco*, 889 F.3d at 1321 ("Regarding the pre-suit business alliance, the Board found that ION and PGS had a contractual and fairly standard customer-manufacturer relationship regarding the accused product. This finding does not necessarily suggest that the relationship is sufficiently close . . . ." (citation omitted)). The Board's Discovery Order did not specifically require evidence of sales of components to Intel for integration in non-accused Intel products because, even if such evidence existed, it would be insufficient to establish privity between Petitioner and Intel based on control of, or an opportunity to control, the relevant litigation.

Providing Custom Products to Customers

To the extent that Patent Owner suggests that, because Ms. Summers "testified that 'MPS sells some custom products,' and [Patent Owner] has previously submitted evidence that Petitioner 'maintains a staff of applications engineers who work directly with [] customers' engineers,'" such collaboration implies privity, presumably with Intel, we disagree. PO Privity Br. 3 (quoting Ex. 2087, 34:11–17; Ex. 2022, 6) (alteration by

Patent Owner). Generally collaborating and making custom products is not dispositive. Instead, what matters for privity is that Petitioner did not make the Intel Accused Products or components thereof such that Petitioner was in a position to or had any opportunity to control the relevant litigation and should not be provided a second bite at the same apple. *See, e.g.*, *WesternGeco*, 889 F.3d at 1319–22 (the parties "had a contractual and fairly standard customer-manufacturer relationship regarding the accused product," which "does not necessarily suggest that the relationship is sufficiently close that both" parties should be considered to be in privity); *Wi-Fi One, LLC v. Broadcom Corp.*, 887 F.3d 1329, 1340–41 (Fed. Cir. 2018) (same); *Samsung Elec. Co. Ltd. v. Netlist Inc.*, IPR2022-00615, Paper 64 at 22–26 (PTAB June 30, 2023) (same).

The Board did not order a particular style or depth of investigation (*see* Disc. Order 6–7), nor do we discern that Petitioner's investigations were in any way insufficient. In particular, we disagree with Patent Owner's position that compliance with the Discovery Order required Petitioner's Declarant to undertake discovery from Intel to determine whether any IAPs that were accused of infringement in the related litigation included components sold or manufactured by Petitioner, much less contact distributors, manufacturing fabrication plants, or corporate affiliates as part of their investigation to discover whether any of Petitioner's products ultimately were included in such IAPs. *See, e.g.*, PO Privity Br. 10–13. Ms. Summers' Declaration produced by Petitioner is sufficient to comply with the Discovery Order.

Moreover, when Patent Owner's counsel was asked whether Patent Owner would request additional discovery pursuant to the Director's Decision vacating and remanding the Final Written Decisions issued in the

first wave cases, Patent Owner's counsel indicated that Patent Owner would not seek additional discovery, preferring instead to "rest on its papers." Paper 44, 3; Disc. Order 4. Thus, it is not clear to us what Petitioner could have produced that would satisfy Patent Owner's demands for an adequate investigation. Furthermore, we are not apprised of, and can discern no evidence of inaccuracies, inconsistencies, or any other impropriety, particularly as Ms. Summers testified under penalty of perjury.

In view of the above, the evidence adduced during trial does not support Patent Owner's argument that Intel should be named as a privy so as to put the issue into dispute. *See* Dir. Rev. Order 3 (making plain that the question on remand is whether Patent Owner has met that burden of production). Moreover, even if Patent Owner had met their burden of production, the totality of evidence adduced during trial does not support a finding that the relationship between Petitioner and Intel is sufficiently close that both should be bound by the trial outcome and related estoppels, nor does it suggest, without more, that the parties were litigating either the district court action or the IPRs as proxies for one another. Further, the record is devoid of evidence that Petitioner had any opportunity to control the Intel litigation.

[redacted] *and* [redacted]

As for Patent Owner's argument that it "maintains that Petitioner is in privity with both [redacted] and [redacted] two other time-barred parties," and "that discovery should have been granted as to these parties for at least the reasons presented in the Joint Paper Concerning Additional Discovery in the Wave 1 (*onsemi*) IPRs," we decline to address this argument. PO Privity Br. 2 n.2 (citing IPR2023-01242, Paper 108, 2–5). The Director Review Order made clear that the Board's Final Written Decisions were remanded to consider

issues of privity with respect to only Intel and we decline to enlarge the scope of the "narrowly tailored" discovery set forth in the Director Review Order. *See* Dir. Rev. Order 3.

According to Patent Owner, "Intel and [redacted] were served with a complaint alleging infringement of the Challenged Patent on February 1, 2022" and "[redacted] was an RPI to the First Amended Complaint against [redacted] (served by ECF on April 29, 2022)." Prelim. Resp. 28 (citing Ex. 2002, 2, 4; Ex. 2001; Ex. 2003; Ex. 2008, 7). "Thus," Patent Owner contends that "the Petition is untimely if Petitioner is in privity with Intel ***or*** [redacted]." *Id.* (emphasis added). In the Board's Discovery Order, we noted that "the Board conducted a teleconference with the parties in the above-captioned proceedings," IPR2024-00468, IPR2024-00469, IPR2024-00470, IPR2024-00550, IPR2024-00551, IPR2024-00552, and IPR2024-00553. Disc. Order 4.

> During the teleconference, the Board inquired as to whether Patent Owner would request additional discovery pursuant to the Director's Decision vacating and remanding the Final Written Decisions issued in the first wave cases. Patent Owner indicated it would not seek additional discovery, preferring instead to "rest on its papers."

Id. (citing IPR2024-00468, Paper 63, 2–3). That the Board chose to *sua sponte* craft a Discovery Order on Patent Owner's behalf, without sufficient input from Patent Owner, can hardly leave the Board to blame if Patent Owner did not obtain the discovery materials and briefing it sought.

Moreover, [redacted] is not alleged to be an RPI or privy of Petitioner. *See* PO Resp. 36 (identifying Licensees as [redacted] Intel, and [redacted]). Rather, [redacted] is alleged to be an RPI of an alleged RPI—[redacted] (*see* PO Resp. 35–36)

—a degree of separation that is not contemplated by the clear language of the statute. Thus, Patent Owner's arguments as to [redacted] are unavailing.

III. PATENTABILITY ANALYSIS

A. Legal Standard

"In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and "the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

In order to determine whether an invention would have been obvious at the time the application was filed, we consider the level of ordinary skill in the pertinent art. *Graham*, 383 U.S. at 17. In assessing the level of ordinary skill in the art, various factors may be considered, including the

"type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field." *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quotation omitted).

Petitioner contends that a person of ordinary skill in the art "would have had a Bachelor's degree in electrical engineering, material science, applied physics, or a related field, and four years of experience in semiconductor design and manufacturing or equivalent work experience." Pet. 10 (citing Ex. 1003 ¶ 18). Petitioner further contends that "[a]dditional education might compensate for a deficiency in experience, and vice-versa." *Id.*

Patent Owner contends that

> [a] person of ordinary skill in the art (POSITA) in the technology field of the Challenged Patent would be a person with at least a Bachelor's of Science degree in electrical or computer engineering, materials science, chemical engineering, applied physics, or a related field, with emphasis on semiconductor manufacturing, or an equivalent degree, and at least four years of experience in semiconductor design and manufacturing.

PO Resp. 8 (citing Ex. 2057 ¶¶ 17–18). Similar to Petitioner, Patent Owner asserts that "[a]dditional education in a relevant field or industry experience may compensate for a deficit in one of the other aspects of the requirements stated above." *Id.*

Upon review of the parties' arguments and the prior art of record, we adopt Petitioner's definition of the person of ordinary skill in the art as it is consistent with the disclosures of the '014 patent and the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (holding that the prior art itself can reflect the appropriate level of ordinary skill in the

art). We note, however, that neither party asserts that the outcome of this proceeding would differ based on the minor differences between the two parties' definitions of an ordinarily skilled artisan. Nor does either party question whether the opposing party's declarant is a person of ordinary skill in the art under either proposed definition.

C. Claim Construction

In an *inter partes* review, claims are construed "using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b)." 37 C.F.R. § 42.100(b). Under that standard, the words of a claim are generally given their "ordinary and customary meaning," which is the meaning the term would have had to a person of ordinary skill at the time of the invention, in the context of the entire patent including the specification. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc).

Both parties agree that express claim construction is not necessary in order to resolve the issues presented in the Petition. *See* Pet. 10; PO Resp. 9.

We note, however, that Patent Owner asks that we "clarify that ["graded dopant concentration" "to aid carrier movement"] are separate terms and that the plain and ordinary meaning of 'aid carrier movement' requires that a carrier move in the specified direction." PO Resp. 10. We address Patent Owner's "aid carrier movement" arguments below in our discussion of the patentability challenge based on Kawagoe in Section III.E.2.b.

After considering the arguments and information presented during trial, we agree that we do not need to otherwise expressly construe any terms in order to resolve the dispute between the parties. *See Realtime Data, LLC*

v. Iancu, 912 F.3d 1368, 1375 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.'" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Objective Indicia of Nonobviousness

Objective indicia of nonobviousness, or secondary considerations of nonobviousness, serve "an important role as a guard against the statutorily proscribed hindsight reasoning in the obviousness analysis," and must be considered in every case in which they are presented. *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1328 (Fed. Cir. 2016). Objective indicia of nonobviousness may include evidence of a long-felt need in the art, praise within the industry, skepticism in the industry about whether or how a problem could be solved, copying, and commercial success. *Id.* at 1132–37.

Patent Owner bears the burden of establishing that a nexus exists between the objective evidence and the claimed invention. *See Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019). Nexus is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining nonobviousness. *See Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988). "A nexus may not exist where, for example, the merits of the claimed invention were 'readily available in the prior art.'" *ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016) (quoting *Richdel, Inc. v. Sunspool Corp.*, 714 F.2d 1573, 1580 (Fed. Cir. 1983)). "Unlike products, which may incorporate numerous features beyond those claimed or described in a patent and therefore may require careful parsing to establish a nexus, actual

licenses to the subject patent do not demand the same, as they are, by their nature, directly tied to the patented technology." *Ancora Techs. Inc. v. Roku Inc.*, 140 F.4th 1351, 1362 (Fed. Cir. 2025) (citing *LaserDynamics, Inc. v. Quanta Computer, Inc.*, 694 F.3d 51, 79 (Fed. Cir. 2012)).

Patent Owner contends that a license agreement with RPX Corp. ("RPX") ("the RPX license") that covers the patent family including the '014 patent is evidence of objective indicia of nonobviousness. *See* PO Resp. 4–5, 32–34. Patent Owner further argues that because the licensees, [redacted] approached Patent Owner through RPX without threat of litigation against them, the RPX license agreement is especially probative of nonobviousness. *See id.* at 32–33 (citing Ex. 2072 (Rao Declaration); *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1353 (Fed. Cir. 2012); *Samsung Elec. Co. Ltd. v. Neonode Smartphone LLC*, IPR2021-00144, Paper 59 at 51 (PTAB Dec. 15, 2022)); *see also* PO Sur-reply 26 (similar arguments). Patent Owner further argues that its invention is "part and parcel" of the RPX license because all of the claims of the licensed patents relate to using graded dopants to move carriers from active circuitry at the surface or active region further down into the device. *See* PO Resp. 33–34 (citing PO Resp. 10–32); PO Sur-reply 26 (citing Ex. 2072 ¶¶ 2–3, pp. 19, 45).[10] Patent Owner further contends that as part of litigation settlements, at least five other large, sophisticated parties have taken licenses, with eight major semiconductor companies having paid a total of more than [redacted] for licenses to just one patent family. *See* PO Resp. 34.

[10] Patent Owner incorrectly cites Exhibit 2078.

Petitioner argues in its Reply that licenses that result from settlement require affirmative evidence of nexus because it is often cheaper to take a license than to defend infringement suits, and [redacted] licenses were made through RPX, which structures its arrangements to avoid litigation costs. *See* Pet. Reply 23–24 (citing *Iron Grip Barbell Co. Inc. v. USA Sports, Inc.*, 392 F.3d 1317, 1324 (Fed. Cir. 2004); Exs. 1060, 1061).

Patent Owner argues in its Sur-reply that "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 avoiding litigation costs.'" PO Sur-reply 26 (citing Pet. Reply 23–24).

We find that there is nexus between the objective indicia and the challenged claims based on the RPX license that includes U.S. Patent Nos. 8,421,195, 9,190,502, 9,647,070, and 10,510,842, in the listing of the patent family covered by the license and from which the '014 patent issued by way of a series of continuing applications. *See* Ex. 1001, code (60); Ex. 2072, pp. 7 (Appendix A "Patents" definition), 19 (Appendix A, Exhibit B); *Ancora*, 140 F.4th at 136.

Here, Patent Owner relies on the RPX license and asserts that its technique of "creating 'a drift field to sweep these unwanted minority carriers from the active circuitry at the surface into the substrate'" (PO Resp. 33 (quoting Ex. 1001, 3:64–67)) is "part and parcel" with the RPX license (*id.*).[11] We have considered the RPX license and Patent Owner's argument. Even though the RPX license conveys a right to the challenged claims sufficient to support a nexus, we decline to give significant weight to the RPX license. We do not agree with Patent Owner that the RPX license

[11] Patent Owner incorrectly references Ex. 1001, 3:52–56.

is especially probative because [redacted] were under no apparent threat of litigation. *See id.* at 32–33. Although Patent Owner argues that the RPX license was not motivated by a threat of litigation, (*see id.*), the weight of evidence does not support those arguments. RPX markets itself as a cost-saving service that spreads litigation cost across a large network of companies and "remove[s] patents from circulation before they become costly issues." Ex. 1060, 1. RPX further markets itself as working on behalf of its clients to prevent potential litigation and associated legal defense costs and settlements. *See* Ex. 1060, 2; Ex. 1061, 1.

In view of this evidence, Patent Owner's argument that [redacted] entered a license under no apparent threat of litigation is not persuasive because it may reflect the value of RPX as a risk mitigation service and, therefore, on this record, does not reflect the value of the challenged patent specifically. *Cf. Transocean*, 699 F.3d at 1353 (License found to be due to the merits of the claimed invention to support nonobviousness where royalties exceeding the cost of litigation reflected the value of the licensed technology); *Samsung v. Neonode*, IPR2021-00144, Paper 59 at 51 (License found to be due to an interest in "[the patent owner's] technology exclusively" and not some "other economic reason that might discount . . . interest in exclusively licensing the technology.").

Unlike in the *Samsung v. Neonode* case, the record here does not provide sufficient evidence that the amount paid for the RPX license is due exclusively to the licensed technology rather than some other economic reason. In addition, unlike in the *Transocean* case, the record here includes no evidence about the size of the contributions of [redacted] made towards the lumpsum licensing fee, relative to the contribution of [redacted] and/or any other RPX member. Ex. 2072 ¶ 6. The record is not

sufficiently developed to determine whether contribution amounts of [redacted] are significant compared to the potential cost of litigation. *See* Ex. 2072.

As to Patent Owner's argument that the license evidences nonobviousness because "moving carriers 'from the active circuitry at the surface' is missing from the prior art" (PO Resp. 34), we disagree for the reasons discussed below. *See Tokai Corp. v. Easton Enters., Inc.*, 632 F.3d 1358, 1369 (Fed. Cir. 2011) ("If commercial success is due to an element in the prior art, no nexus exists."); *Ormco Corp. v. Align Technology, Inc.*, 463 F.3d 1299, 1312 (Fed. Cir. 2006) ("[I]f the feature that creates the commercial success was known in the prior art, the success is not pertinent."). Accordingly, we find that the RPX licenses are not entitled to significant weight.

Having determined the weight to be given to Patent Owner's licenses, we turn to the evidence and argument regarding the remaining *Graham* factors, discussed below, in evaluating Petitioner's obviousness contentions as to each of the challenged claims. Even if we were to give the RPX license significant weight, we determine that Petitioner's showings of *prima facie* obviousness, particularly in view of the strength of the patentability challenges based on Kawagoe (single reference obviousness challenge), Onoda (single reference obviousness challenge), and Onoda and Nishizawa discussed below outweigh Patent Owner's objective evidence of nonobviousness. *See Tokai*, 632 F.3d at 1371 ("A strong case of prima facie obviousness . . . cannot be overcome by a far weaker showing of objective indicia of nonobviousness.")

E. Patentability Challenge Based on Kawagoe

Petitioner contends the subject matter of claims 1, 3–9, 13, 15–17, 20, 21, and 23–28 would have been obvious over of Kawagoe. *See* Pet. 15–41.

1. Overview of Kawagoe (Ex. 1007)

Kawagoe discloses a process for manufacturing a semiconductor integrated circuit device using an epitaxial wafer, i.e., a semiconductor wafer having a semiconductor single crystal epitaxial layer grown over a polished semiconductor substrate. *See* Ex. 1007, 1:13–27, 2:31–35. According to Kawagoe, "[t]he epitaxial wafer is advantageous in that it is excellent in suppressing the soft errors and resisting to the latchup,"[12] and also has "excellent breakdown characteristics" that "drastically reduce the defect density of the gate insulating film" of a semiconductor integrated device. *Id.* at 1:33–40.

Kawagoe discloses various "representative" processes, including processes in which the single crystal (epitaxial) layer contains an impurity of the same type and in the same concentration as the substrate body. *See* Ex. 1007, 2:55–3:9. According to Kawagoe, the impurity concentration of the substrate body can be made higher than that of the epitaxial layer "so that the resistance of the semiconductor substrate body can be relatively lowered to improve the resistance to the latchup." *Id.* at 4:1–8. Kawagoe

[12] Petitioner submits Exhibit 1013 (Wang and Agrawal, *Single Event Upset: An Embedded Tutorial*, 21st Int'l Conf on VLSI Design, 429–434, IEEE 2008), which explains that "soft errors" are "random and not related to permanent hardware faults" and "[t]heir causes may be internal (e.g., interconnect coupling) or external (e.g., cosmic radiation)," including "alpha particles [that] are emitted when the nucleus of an unstable isotope decays to a lower energy state." Ex. 1013, Abstract, 430.

discloses a process for manufacturing a semiconductor integrated circuit device including a step of forming a semiconductor region (well) extending below the epitaxial layer and having an impurity concentration that decreases with increasing depth below the epitaxial layer. *See id.* at 3:10–25. According to Kawagoe, the well can be used for forming a complementary Metal-Oxide-Semiconductor.Field-Effect-Transistor ("MOS.FET") circuit. *See id.* at 3:32–38.

Kawagoe describes seven embodiments, including Embodiment 1 (*see* Ex. 1007, 6:41–12:40, Figs. 1–8) and Embodiment 4 (*see id.* at 14:46–19:63, Figs. 16–25).

Figure 1 of Kawagoe is reproduced below.

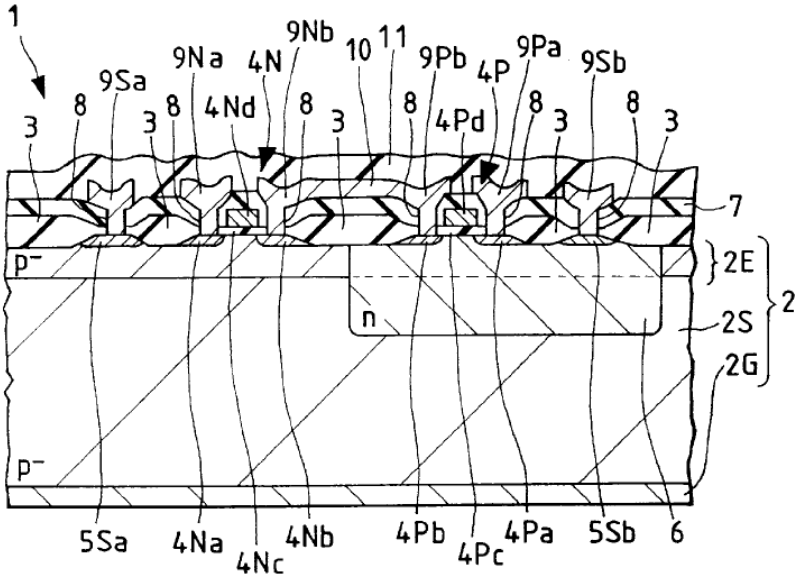


Figure 1 depicts "an essential portion of a semiconductor integrated circuit device" that includes semiconductor substrate body 2S, epitaxial layer 2E, and gettering layer 2G. Ex. 1007, 6:51–56, Fig. 1 (Embodiment 1). Substrate body 2S and epitaxial layer 2E are doped with a p-type impurity in equal concentrations. *Id.* at 6:60–7:3, 10:51–55, 11:12–16. Embodiment 1 includes n-channel MOS.FET ("nMOS") 4N and p-channel MOS.FET

("pMOS") 4P, the latter being formed in n-well 6, which is doped with n-type impurity and extends below the epitaxial layer. *See id.* at 8:46–52, 9:32–40, 11:18–24, 11:43–50, Figs. 1, 5, 7.

Figure 16 of Kawagoe is reproduced below.

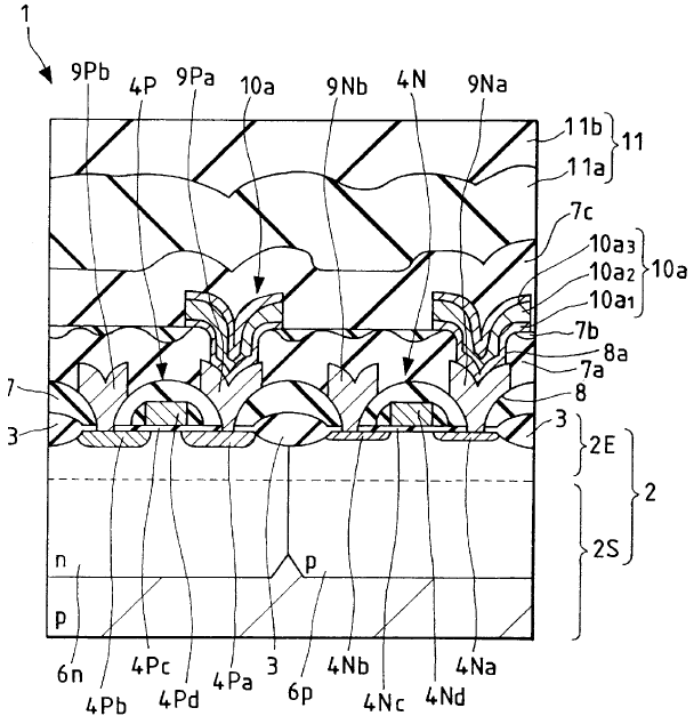


Figure 16 "is a section showing an essential portion of a semiconductor integrated circuit device according to" one embodiment of Kawagoe. Ex. 1007, 5:38–40 (Embodiment 4). In the device depicted in Figure 16, substrate body 2S is relatively lightly doped with a p-type impurity, such as boron. *See id.* at 14:61–67. Epitaxial layer 2E is made of a p^--type Si single crystal that is formed over a principal surface of substrate body 2S and doped with a p-type impurity in a concentration that is lower than that of substrate body 2S. *See id.* at 15:1–6.

Figure 17 of Kawagoe is reproduced below.

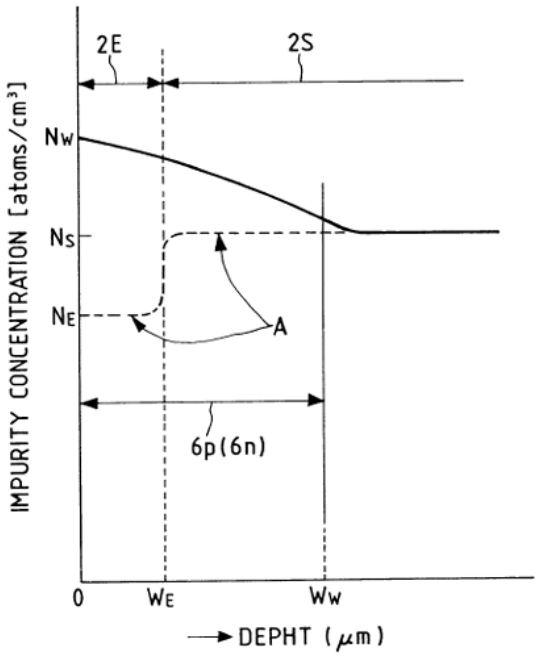


Figure 17 is a plot of impurity concentration as a function of depth in a semiconductor integrated circuit device, which shows "the p-well 6*p* and n-well 6*n* have their impurity concentrations gradually lowered in the depthwise direction from the principal surface (having an impurity concentration N_W) of the epitaxial layer 2E." Ex. 1007, 5:41–45, 15:62–16:5.

Kawagoe explains that:

> the impurity concentration of the p-well 6p is given such a gradient that it is gradually lowered in the depthwise direction from the surface of the epitaxial layer 2E, so that the influence to be caused by the carriers (or electrons) due to the α-ray is lowered. Specifically, the electrons produced by the α-ray are attracted to the substrate body 2S by that concentration gradient and prevented from entering the p-well 6p so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well 6.

Ex. 1007, 16:2–11.

Figure 23 of Kawagoe is reproduced below.

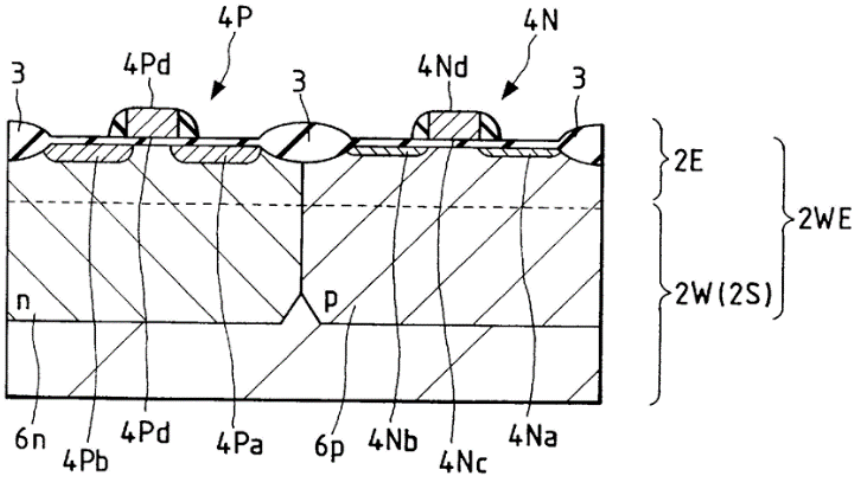


Figure 23 depicts a step in a process for manufacturing the semiconductor integrated circuit device of Embodiment 4. *See* Ex. 1007, 17:11–13. Figure 23 depicts p-well 6*p* formed with nMOS 4N and n-well 6*n* formed with pMOS 4P, and field insulating film 3. *See id.* at 6:1–4, 15:26–32, 17:11–13, 18:3–35.

2. Analysis—Claim 1 and Independent Claim 21

a. Undisputed Limitations of Claims 1 and 21

The preamble and first clause of independent claims 1 and 21 recites "An electronic system, [the system] comprising: at least one semiconductor device, the at least one semiconductor device including."[13] Ex. 1001, 4:49–51, 6:4–6. Petitioner contends that, Kawagoe teaches the preamble and first limitation based on Kawagoe's disclosure of a "semiconductor integrated circuit device," such as a microcomputer and memories, that each constitute an electronic system. *See* Pet. 15–16, 38 (citing Ex. 1007, 1:13–23, 24:21–31; Ex. 1003 ¶¶ 151, 458).

[13] We use bracketed language to show the differences between claims 1 and 21.

Claims 1 and 21 recite "a substrate of a first doping type at a first doping level having a surface." Ex. 1001, 4:52–53, 6:7–8. Petitioner contends that Kawagoe discloses or teaches this limitation based on the disclosure of substrate 2 that includes a p-type Si body 2S and a p-type single crystal epitaxial layer 2E. Pet. 16–17 (reproducing Ex. 1007, Fig. 16; citing Ex. 1007, 14:64–15:2, 15:11, 15:26; Ex. 1003 ¶¶ 152–157, 459). Petitioner further contends that substrate 2 has various surfaces between different layers of components, and identifies the top surface of epitaxial layer 2E as a first surface and the bottom surface of N well 6n and P well 6p as the second surface. *See* Pet. 16.

Claims 1 and 21 also recite "a first active region disposed adjacent the surface [of the substrate] with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed [in the surface thereof]." Ex. 1001, 4:54–57, 6:9–13. Petitioner contends that Kawagoe discloses or teaches this limitation based on the n-type region-well 6n shown in Figure 16 that includes an active surface forming the source, drain, and channel of PMOS transistor 4P that has a second doping type (n-type) that is opposite in conductivity to the first doping type (p-type). *See* Pet. 18–19 (reproducing Ex. 1007, Figs. 16, 22, 23 (with Petitioner's annotations added); citing Ex. 1007, 9:41–51, 14:61–15:12, 15:26–43, 18:18–23, Ex. 1008, 299; Ex. 1003 ¶¶ 158–165, 460). Petitioner further contends that a POSITA would have understood that transistors may be formed in this first active region. *See* Pet. 20 (citing Ex. 1003 ¶¶ 163–164, 460).

Claims 1 and 21 also recite "a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed [in the surface thereof]" and "transistors

formed in at least one of the first active region or second active region." Ex. 1001, 4:58–62, 6:14–19. Petitioner contends that Kawagoe teaches or suggests a "second active region" that separate from and adjacent to the first active region and includes the source, drain, and channel regions that form the NMOS transistor in p-well 6p of Figure 16. *See* Pet. 20–22 (reproducing Ex. 1007, Fig. 16 (with Petitioner's annotations added); citing Ex. 1007, 8:55–9:6, 15:28–30, 18:9–38; Ex. 1003 ¶¶ 35–45, 166, 168, 461, 462; Ex. 1051, Ex. 1052). Petitioner further contends that transistors are formed in the first and second active regions to form a PMOS transistor 4P and an NMOS transistor 4N. *See* Pet. 24.

Claim 1 further requires "wherein at least some of the transistors form digital logic of the semiconductor device." Ex. 1001, 5:5–7. Petitioner contends that Kawagoe discloses that its techniques may be applied to a "semiconductor integrated circuit device which has a logic circuit such as the so-called 'microcomputer.'" *See* Pet. 30 (quoting Ex. 1007, 24:28–31; citing Ex. 1003 ¶ 465).

Claim 21 further requires "wherein the graded dopant concentration is linear, quasilinear, error function, complementary error function, or any combination thereof." Ex. 1001, 6:30–33. Petitioner contends that Kawagoe teaches or suggests this limitation based on Kawagoe's Figure 17 disclosing either linear or quasi-linear or exponential gradients. *See* Pet. 38–39 (reproducing Ex. 1007, Fig. 17 (with Petitioner's added annotations); citing Ex. 1007, 16:16–40; Ex. 1003 ¶¶ 378, 485). Petitioner further contends that one of ordinary skill in the art would have understood that either type of dopant profile would improve the transport of minority carriers to the substrate. *See id.* at 39–40.

Patent Owner does not dispute Petitioner's contentions that Kawagoe teaches the aforementioned undisputed limitations of claims 1 and 21. *See* PO Resp. 20–26. Based on the complete record developed during trial, we determine that Petitioner persuasively demonstrates that Kawagoe teaches or suggests the aforementioned undisputed limitations of claims 1 and 21.

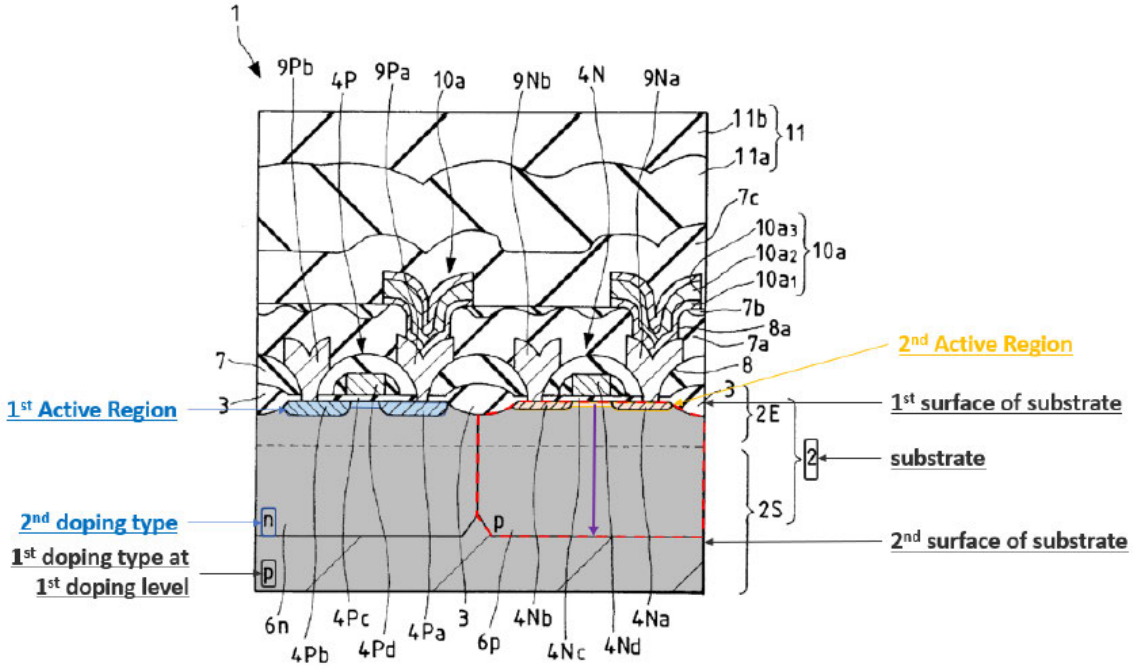
b. Disputed Limitations of Claims 1 and 21

Claims 1 and 21 also recite the following disputed limitations (*see* PO Resp. 10–30):

> at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the [first and second active regions towards/surface to] an area of the substrate where there are no active regions; and at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface [towards/to] the area of the substrate where there are no active regions.

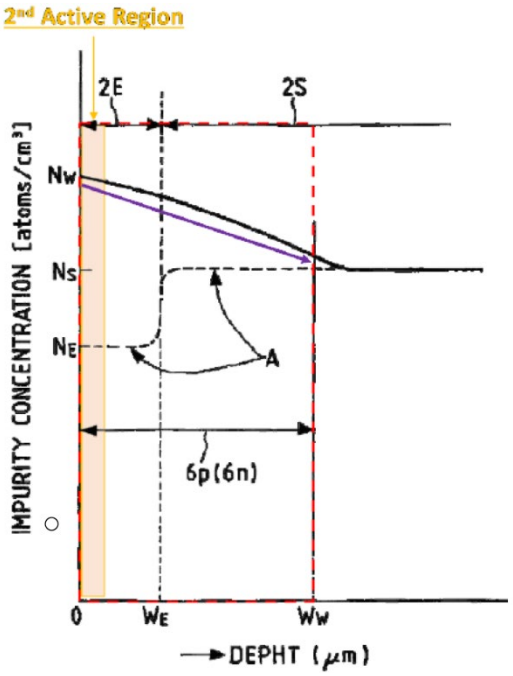
Ex. 1001, 4:63–5:5, 6:20–29.

Figure 16 of Kawagoe, annotated by Petitioner, is reproduced below.



Annotated Figure 16 depicts the first active region (blue), the second active region (yellow) n-well 6n, p-well 6p (red dashes), and movement of carriers (purple arrow). *See* Pet. 24–26. Petitioner contends that Kawagoe's Figure 17 illustrates the doping concentration as a function of depth of the physical device depicted in Figure 16. *See* Pet. 24 (citing Ex. 1007, 14:46–67, 15:62–16:15).

Figure 17 of Kawagoe, annotated by Petitioner, is reproduced below.



Annotated Figure 17 depicts second active region (yellow) and p-well (red dashes). *See* Pet. 24–27. Referring to annotated Figures 16 and 17 Petitioner asserts, "the 'second active region' at the top surface of the p-well 6p in the substrate is where the downward dopant gradient begins, and it levels off shortly after the well 6p (red-dashed annotation)." Pet. 25 (citing Ex. 1003 ¶¶ 245, 246, 463); *see* Pet. 25–27 (citing Ex. 1003 ¶¶ 171–178, 245, 246, 462, 463); *see also* Pet. 25 n.6 (explaining the graded dopant profile applies to both the n-well and p-well which would drive electrons in the p-well 6p downward and drive holes in the n-well 6n downward, citing Ex. 1007, 16:1–16; Ex. 1003 ¶¶ 66–69, 101, 113–116). According to Petitioner, "[s]imilarly, the 'first active region' at the top surface of the n-well 6n in the substrate also has a downward dopant gradient which levels off when the depth goes beyond the n-well 6n into the lower part of the substrate." Pet. 25 (citing Ex. 1003 ¶¶ 245, 463); *see* Pet. 25–27 (citing Ex. 1003 ¶¶ 171–178, 245, 246, 462, 463). Petitioner

further asserts that "[a]s shown in FIG. 17, Kawagoe's downward graded dopant concentration for each of the p-well 6p and n-well 6n is present from the top surface to the bottom surface of each well to generate a drift electric field to move their respective minority carriers downward to the bottom surface of each well." Pet. 27 (citing Ex. 1003 ¶¶ 173–178, 463).

Petitioner explains:

> Kawagoe's dopant gradient in the p-well 6p is designed to aid carrier movement of electrons from the top surface of the substrate 2 to attract electrons to the substrate body 2S. . . . Kawagoe states that "the impurity concentration of the p-well 6p is given such a gradient that it is gradually lowered in the depthwise direction from the surface of the epitaxial layer 2E, so that the influence to be caused by the carriers (or electrons) due to the α-ray is lowered. Specifically, the electrons produced by the α-ray are attracted to the substrate body 2S by that concentration gradient and prevented from entering the p-well 6p so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well 6p."

Pet. 27 (quoting Ex. 1007, 16:2–11; citing Ex. 1007, 15:62–16:40); *see* Pet. 15 (similar argument, citing Ex. 1007, 15:62–16:40). Further according to Petitioner,

> Kawagoe provides p-well 6p . . . that is adjacent to the first active region . . . ha[ving] a graded dopant region from its surface (through the second active region) that aids the movement of carriers from the claimed surface (annotated first surface). A POSITA would further understand that the n-well 6n (another well region) is similarly adjacent to the second active region.

Pet. 28 (citing Ex. 1003 ¶¶ 246, 464); *see* Pet. 28–30 (reproducing Ex. 1007, Figs 16, 17 (with Petitioner's annotations added); citing Ex. 1007, 1:59–2:5, 2:20–23, 15:26–36, 15:62–16:40, 17:11–21; Ex. 1003 ¶¶ 246, 248–250, 464).

Petitioner notes that during prosecution of U.S. Patent No. 8,421,195 ("the 195 patent" or "the parent '195 patent") a parent to the '014 patent (*see* Ex. 1001, code (60)), Applicant admitted that downward-sloping graded dopant concentrations were known in the art to create an "inherent 'built-in' unidirectional electric field." Pet. 12 (citing Ex. 1002, 289–90); *see id.* at 56 (similar argument, citing Ex. 1003 ¶¶ 47, 103, 418). Petitioner further contends that Applicant represented to the Office that "a unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way" and "[d]epending on the particular slope of the graded concentration of dopant, all minority carriers are either swept 'down' . . . or 'up . . . .'" Pet. 12–13 (quoting Ex. 1002, 289) (second and third alterations by Petitioner); *see id.* at 56 (similar argument, citing Ex. 1003 ¶¶ 47, 103, 418). Petitioner further notes that Applicant cited U.S. Patent No. 4,481,822 to Jastrzebski (Ex. 1010), which "teaches a downward-sloping graded-dopant concentration creates an electric drift field that 'force[s] most of the charge carriers . . . deep into the substrate[.]'" Pet. 13–14 (reproducing Ex. 1010, Figs. 1a, 1b (with Petitioner's annotations added); quoting Ex. 1010, 5:14–22; citing Ex. 1010, 2:27–32) (alterations by Petitioner. Finally, Petitioner notes that Applicant similarly cited U.S. Patent No. 4,160,985 to Kamins (Ex. 1009) to demonstrate that a downward sloping graded dopant concentration will cause minority carriers to be accelerated into the substrate. *See* Pet. 14–15 (reproducing Ex. 1009, Fig. 3 (with Petitioner's annotations added); citing Ex. 1002, 237–38, 253–54, 318, 333).

i. Patent Owner's Arguments

Petitioner's Challenge Does Not Calculate Magnitude of the Slope of the Graded Dopant Concentration

Patent Owner contends that Petitioner's challenge is based on inherency and that, as such, "[t]he 'probability or possibility' that a dopant gradient aids carrier movement 'is insufficient.'" PO Resp. 2 (citing *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999)). According to Patent Owner, "[t]he prior art 'must *necessarily* include the unstated limitation.'" *Id.* at 2–3 (citing *Transclean Corp. v. Bridgewood Servs., Inc.*, 290 F.3d 1364, 1373 (Fed. Cir. 2002)); *see id.* at 17 (citing *Phillips*, 415 F.3d at 1314). Patent Owner contends that "Petitioner's references do not teach the 'aid carrier movement' claim limitations" and that, "[t]herefore, to locate 'aid carrier movement' in the prior art, the Petition assumes that *any* 'graded dopant concentration' will 'aid carrier movement.'" *Id.* at 10; *see id.* at 17.

Patent Owner contends that the specification describes that "the slope of the dopant concentration is a relevant parameter for determining whether a concentration gradient will aid carrier movement." PO Resp. 14–15 (quoting Ex. 1001, 2:66–3:15).[14]

Patent Owner further asserts that "[n]ot one but two District Courts have previously agreed with Greenthread that not *all* doping gradients aid carrier movement." PO Resp. 17. According to Patent Owner, "[t]he Western District of Texas unequivocally stated, 'a graded concentration . . . that is [not "sufficiently graded"] will not aid in the movement of minority carriers[.]'" *Id.* (alterations by Patent Owner) (citing Ex. 2074, 39–40).[15]

[14] Patent Owner incorrectly cited Ex. 2061.

[15] Exhibit 2074, "WDTX Markman Order."

Patent Owner further argues that "the Eastern District of Texas understood that direction alone does not determine whether a gradient aids carrier movement—the ***magnitude*** of the gradient must also be considered." *Id.* at 17–18 (citing Ex. 2075, 15).[16] According to Patent Owner, the EDTX Markman Order explains "that 'the slope [of the gradient] has both a direction and a magnitude and [d]efendant [incorrectly] suggests that the direction of the drift electric field depends solely on ***the direction*** of the slope of the graded concentration.'" *Id.* at 18 (quoting Ex. 2075, 15) (alterations and emphasis by Patent Owner).

Patent Owner also argues that

> Petitioner's construction—that actual movement is not required—does render the claimed limitation "superfluous." This is like arguing that a person can "aid movement" by pushing on a parked car. Even Petitioner's own expert understood "aiding carrier movement" to refer to "sweeping carriers from the active circuitry at the surface into the substrate." "Sweeping" the carriers means "moving" the carriers, and to argue otherwise is contrary to the surrounding claim language and the patent's specification.

PO Sur-reply 13–14 (quoting Ex. 1003 ¶¶ 26, 46 (Patent Owner's alterations)); citing Pet. Reply 3–4; Ex. 1055, 67:25–68:19). Patent Owner asserts that Petitioner relies on an incorrect construction that would eviscerate the stated purpose of the claimed invention. *See id.* at 14 (citing *Sequoia Tech., LLC v. Dell, Inc.*, 66 F.4th 1317, 1326 (Fed. Cir. 2023); *KEYnetik, Inc. v. Samsung Elecs. Co., Ltd.*, 837 F. App'x. 786, 792 (Fed. Cir. 2020)). According to Patent Owner, "[t]o improve performance of the claimed transistor, the minority carriers must not only *move*, but they must

[16] Exhibit 2075, "EDTX Markman Order."

move in the correct direction, ***from*** the 'first surface' to deeper in the substrate." *Id.* at 14.

Petitioner's Challenge Does Not Account for Additional Forces Acting on a Carrier

Patent Owner contends that "Petitioner's assumption that the gradients in their prior art references would aid carrier movement fails, because the Petition fails to analyze whether the specific gradients at issue in the context of the disclosed devices would suffice to overcome the other forces that are present." PO Resp. 15–16. According to Patent Owner, "if the forces acting on a carrier—i.e. the force exerted by a gradient and any other forces—cancel each other out, the carriers do not move at all." *Id.* at 17.

In support, Patent Owner contends that,

> [d]uring prosecution, the examiner likewise said that in "a complex electronic device, movement of minority carriers is affected by multiple forces and fields" and that a "drift field may attempt to apply a force on all minority carriers in a specific direction" but that "without knowing other parameters of the device" one cannot say whether the field would aid carrier movement.

Id. at 15 (quoting Ex. 1002, 270).[17]

According to Patent Owner, "Petitioner's expert admitted in his report that a graded concentration of dopants does not inherently aid minority carrier movement." PO Resp. 10. Patent Owner asserts that Dr. Campbell testified in his report that "an electric field *that is properly constructed* will push the minority carriers away from the surface," and re-confirmed "during his second deposition that '[t]he electric field [from a gradient] will provide a force' but '[t]here may be other forces acting upon the carriers, and *you*

[17] Petitioner incorrectly cites Ex. 2080.

have to add all of the forces.'" *Id.* at 10–11 (quoting Ex. 1003 ¶ 32 (emphasis by Patent Owner); Ex. 2085, 42:12–17 (emphasis and alterations by Patent Owner)); *see id.* at 11 (citing Ex. 2085, 95:14–17, 154:15–18). According to Patent Owner, "Dr. Campbell specifically identified other forces that need to be considered when determining the effect of a doping gradient," including "temperature, capacitance effects at the PN junction, and imperfections in the silicon crystal." *Id.* at 11 (citing Ex. 2085, 34:15–36:19, 39:8–12).

"With regards to PN junction capacitance," Patent Owner contends that "Dr. Campbell testified that '[i]t creates a fairly substantial electric field in the depletion region . . . near the junction,' which he said *is in addition to* the field created by the dopant gradient." PO Resp. 12 (citing Ex. 2058, 35:22–36:4; Ex. 2057 ¶ 60) (alterations by Patent Owner). Patent Owner further contends that "Petitioner's representations to the Office also confirm[] that capacitance effects must be considered to determine the effect of a graded dopant profile." *Id.* (citing Ex. 2030 (U.S. Patent No. 8,704,292), 7:4–7 ("*a graded doping profile**, in combination with*** the capacitive depletion effect . . . , may provide a substantially uniform electric field within the drift region.")). According to Patent Owner, "however, the Petition and Dr. Campbell's report do not discuss the PN junctions in the prior art devices." *Id.*

Patent Owner argues:

> Petitioner's assumption that the gradients in their prior art references would aid carrier movement fails, because the Petition fails to analyze whether the specific gradients at issue in the context of the disclosed devices would suffice to overcome the other forces that are present. Since Petitioner does not measure or account for these forces, and does not compare them to the magnitude of the force exerted by the gradients in

> the alleged prior art, they fail to establish that the disclosed gradients would "aid carrier movement."

PO Resp. 15–16 (citing Ex. 2057 ¶¶ 54–58, 60, 64).

Prosecution History Supports Patent Owner

According to Patent Owner, "Petitioner says that Greenthread argued in prosecution that the 'graded dopant concentration itself creates a "built-in" electrical field that forces the movement of carriers into a particular direction.'" PO Resp. 18 (citing Pet. 56). Patent Owner argues "[t]he point of the sentence Greenthread actually wrote is that a 'graded dopant concentration' must move carriers *to meet the claim limitation*, not that any and every graded dopant concentration must move carriers" and "Greenthread was emphasizing that 'aid carrier movement' is a separate claim element from 'graded dopant concentration'—the exact opposite of what Petitioner asserts." *Id.* at 18–19. Patent Owner contends that "[t]he prosecution history cannot overcome the clear claim language distinguishing the 'graded' and 'aided' terms." *Id.* at 18. According to Patent Owner, "[i]n context," its position is this:

> Defendants assert that the specification does not provide guidance on how to assess or measure carrier movement. This is not true. The claims and the specification make clear that the electric field must move the carriers in a particular direction (from the surface layer to the substrate). Whether the carrier movement has a particular speed or acceleration is beyond the scope of the claim, as long as it meets the other limitations of the claim.

Id. at 19 (quoting Ex. 1030 (Patent Owner's Responsive Claim Construction Brief in *Greenthread, LLC, v. Intel Corporation*, No. 6:22-cv-105 (W.D. Tex. filed Jan. 27, 2022), 38).[18]

In response to Petitioner's assertion that Greenthread represented during prosecution that downward-sloping graded-dopant concentrations were known and created an inherent built-in unidirectional electric field (*see* PO Resp. 19; Pet. 12, 56), Patent Owner contends that, during prosecution of the parent '195 patent, it "added that the movement of carriers '[d]epend[s] on the particular slope of the graded concentration of dopant[s].'" PO Resp. 19 (citing Ex. 1002, 289) (alterations by Patent Owner). According to Patent Owner, "[t]hose additional claim limitations were, as Greenthread said, an 'additional parameter for ensuring that all minority carriers are moved in one direction.'" *Id.* (quoting Ex. 1002, 290). Patent Owner argues "[t]he fact that an 'additional parameter' besides the graded dopants is necessary to 'ensur[e] that all minority carriers are moved' shows that Greenthread was not asserting that 'graded' entails 'aided.'" *Id.* at 19–20 (second alteration by Patent Owner).

Kawagoe Teaches Inhibiting, Not Aiding, Carrier Movement

Patent Owner contends that "Kawagoe teaches using a graded slope to *impede* carrier movement" and "proves that graded dopant concentrations don't *always* aid carrier movement," as Petitioner claims, because sometimes the 'concentration gradient' can 'prevent' carrier movement." PO Resp. 16 (citing Ex. 2057 ¶¶ 62–68); *see id.* at 22 (citing Ex. 2057 ¶¶ 61–68). According to Patent Owner,

[18] Here and throughout this Decision, we refer to the page numbers in the document header of Exhibit 1030.

> Kawagoe is concerned with naturally occurring α-rays striking a semiconductor device and generating free electrons in the substrate. These free electrons can disrupt the operation of the device during a "single event upset" ("SEU"). Kawagoe teaches a "concentration gradient" to "*prevent*[] [these SEU-generated carriers] from entering the p-well."

Id. at 16 (quoting Ex. 1007, 16:7–11).

Whether There Are Carriers in Kawagoe's Active Region

Patent Owner argues that "[t]he carriers that Kawagoe describes are not in the 'active region.'" PO Resp. 21. According to Patent Owner, "[e]very challenged independent claim requires "*active regions* having at least one graded dopant concentration to aid carrier movement," and "Kawagoe does not teach that its gradient would have any effect on carriers in the 'active region.'" *Id.* According to Patent Owner, Kawagoe states:

> Specifically, the electrons produced by the α-ray are attracted to the substrate body 2S by that concentration gradient and *prevented from entering the p-well 6p* so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well 6p.

Id. at 21–22 (quoting Ex. 1007, 16:7–11) (highlighting omitted). Patent Owner contends:

> Kawagoe does not address carriers in the "active region," and does not "aid carrier movement *from the [first and second active regions | first or second active region | surface]*" because Kawagoe's carriers are nowhere near what Petitioner identifies as the "surface" or first/second "active regions" and are in fact "*prevented from entering the p-well 6p*" which stands between them and the "active regions."

Id. at 22 (citing Ex. 2057 ¶ 62). According to Patent Owner, "Dr. Campbell confirmed that Kawagoe's teaching is about preventing carriers at the bottom from moving up, not about moving carriers at the top down." *Id.*

at 23 (citing Ex. 2058, 43:8–20).

Patent Owner also argues that "Petitioner's understanding of Kawagoe's disclosure regarding electrons generated by alpha-rays is incorrect." PO Resp. 23 (citing Ex. 2057 ¶¶ 45, 66–68). "As explained by Dr. Glew—who has experience working with alpha-rays/alpha particles—a POSITA would have understood when Kawagoe mentions 'electrons produced by the α-ray', Kawagoe is *not* describing electrons near the surface." *Id.* (citing Ex. 2057 ¶¶ 61–68; Ex. 1007, 16:7–11).

Patent Owner further argues that "[t]he Petition does not include any obviousness arguments or cite Dr. Campbell for any obviousness rationale/evidence to support modifying Kawagoe to influence carriers in the surface or active region." PO Resp. 24 (citing Pet. 24–28); *see id.* at 23–25 (asserting the Kawagoe cannot be modified to address carriers in the active region).

ii. Petitioner's Reply

Magnitude of Slope of Graded Dopant Concentration

Petitioner contends that the district court orders cited by Patent Owner "involved different disputes and held that the claimed 'graded concentration' merely requires a relative slope." Pet. Reply 4 (citing PO Resp. 17–18). With respect to the WDTX Markman Order, Petitioner contends that "[t]he W.D. Texas order addressed the indefiniteness of a "graded concentration." . . . The parties disputed whether "graded" had any meaning; [Patent Owner] successfully argued that the specification sufficiently depicted "graded" because it depicted a downward slope." *Id.* (citing Ex. 2074, 32, 36, 38–39, 41). With respect to the EDTX Markman Order, Petitioner contends that

> [t]he E.D. Texas order construed the "single drift layer" and its "unidirectional electric field." . . . . The court addressed whether the construction required a non-varying, constant slope and held that "the slope of the graded concentration need not be solely decreasing or solely increasing to yield the recited 'unidirectional electric drift field.'"

Id. at 4–5 (citing Ex. 2075, 10, 11).

Petitioner contends that Patent Owner's arguments "directly contradict[] arguments it made during prosecution of the '195 Patent to overcome § 112 rejections." Pet. Reply 5 (citing IPR2023-01243, Paper 82 at 35). According to Petitioner, during prosecution of the '195 patent, Applicant stated that

> "a unidirectional drift (electric) field ***necessarily affects all*** the present minority carriers in the same way—***moving all*** minority carriers in the same direction…" Applicant argued that the USPTO had failed to recognize that "the ***graded dopant concentration itself*** creates a 'built-in' electrical field that ***forces the movement*** of carriers into a particular direction." . . . . Applicant went further—"without conceding Applicant's position on this issue," it amended the claims by deleting "drawing all minority carriers" and substituting "aid the movement of minority carriers," and argued that a graded dopant concentration inherently aids movement. . . . . Applicant unequivocally committed itself to the position that a downward dopant gradient, by itself, "aid[s] the movement of minority carriers."

Id. at 5–6 (quoting Ex. 1002, 286, 289–90) (emphases, first and fourth alterations added by Petitioner)).

Petitioner also contends that

> [Patent Owner] also contradicts its argument in district court that "aid the movement" is "a simple term" . . . that is definite because "[e]lectric drift fields are a well-known phenomenon that cause carriers to move, and a POSITA would have readily recognized that when a 'static unidirectional electric drift field'

> is present that [sic] it aids the movement of minority carriers." . . . . [Patent Owner] continued: "[w]hile the claims require that the graded dopants create an electric field that aids movement of the carriers, ***they do not require*** a specific range of doping, a particular doping field, or ***a particular result***, and this information is not necessary to understand the scope of [Inventor's] invention." . . . . Those statements directly contradict [Patent Owner]'s arguments that a slope's magnitude, and the combined force effect, must be calculated to reach the limitation.

Pet. Reply 7 (quoting Ex. 1030, 25, 26, 28) (emphases by Petitioner, some alterations by Petitioner). According to Petitioner, "to convince the USPTO to issue its claims, and to convince the district court that 'aid the movement' is sufficiently definite, PO argued that a downward dopant gradient—in itself—aids carrier movement and that a POSITA would understand as much," and accordingly, "PO is now precluded from disavowing those statements." *Id.*

Accounting for Additional Forces

Petitioner contends that the challenged claims "describe a device's *structure*, not a method and active performance." Pet. Reply 3–4 (citing *ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018)). Petitioner argues that the claims "merely require that the claimed 'graded dopant concentration' 'aid carrier movement'—***not*** that it generate a field to overcome all other theoretical forces (none of which are identified the specification, prosecution history, or the cited prior art) that may exist within a theoretical device." *Id.* at 4 (citing *ParkerVision*, 903 F.3d at 1361).

Petitioner contends that even though Patent Owner argued during the district court litigation, to avoid indefiniteness, that "the graded dopant concentration is like a wheelchair ramp, and 'nobody would dispute that a wheelchair ramp "aids the movement" of someone in a wheelchair,'" Patent

Owner now "improperly seeks to concoct and apply a rigid test requiring all conceivable, hypothetical forces be calculated to reach obviousness." Pet. Reply 10–11 (quoting Ex. 1030, 35; citing *id*. at 36–37); *KSR*, 550 U.S. at 403.

Petitioner contends that Patent Owner's "listing of other supposed 'forces' does nothing to counteract the dopant gradient's drift field." Pet. Reply 14 (citing PO Resp. 11–12). According to Petitioner, "[e]xcept for the P-N junction capacitance, [Patent Owner]'s purported 'forces' are not forces at all." *Id*. Petitioner contends that while "the force introduced by the P-N junction capacitance . . . —theoretically—could affect the direction of carrier movement," "the '014 Patent and prosecution history of it says ***nothing*** about such capacitance, much less (1) attributes any significance to it, (2) suggests that it might counteract the drift field created by the dopant gradient, or (3) claims the capacitance as a problematic force." *Id*. at 14–15. According to Petitioner, "[m]oreover, the field effect from the P-N junctions requires an applied voltage for electrons to flow, which the claims do not require." *Id*. at 15 (citing Ex. 2058, 35:10–17; Ex. 1059, 18–20). Petitioner contends that "[t]he graded dopant concentration is ***static***—always present regardless of the device's power state." *Id*.

Prosecution History

Petitioner contends that Patent Owner "wrongly states the Examiner argued that '"without knowing other parameters of the device" one cannot say whether the field would aid carrier movement.'" Pet. Reply 8 (quoting PO Resp. 15). According to Petitioner,

> In actuality, the cited rejection did not address the "aid the movement" limitation which was added *in response to* the cited rejection. (rejection for "drawing all").) . . . . *After* this

> rejection, Applicant removed "drawing all" and added "aid the movement of" to the claims. . . . . Applicant argued that the drift field affects all carriers and the Examiner had not properly recognized that "the graded dopant concentration itself creates a 'built-in' electric field that forces the movement of carriers." . . . . The claims were subsequently allowed.

Id. (citing Ex. 1002, 270, 286, 289, 341).

Petitioner also asserts that Patent Owner "falsely claims that, during prosecution, it argued that the graded dopant concentration must move carriers and emphasized that 'aid the movement of minority carriers' is a separate element from the graded concentration of dopants." Pet Reply 8 (citing PO Resp. 18–19). According to Petitioner, Patent Owner's "alleged support does not come from the prosecution history," rather "it cites a section of its claim construction brief—that did not deal with the prosecution history—against Intel." *Id.* (citing PO Resp. 18–19 (citing Ex. 1030, 38)).

Petitioner also contends that Patent Owner "falsely claims Applicant emphasized the slope's magnitude during prosecution." Pet. Reply 9 (citing PO Resp. 19–20). According to Petitioner, "[i]n actuality, Applicant emphasized the slope's *direction*, not its *magnitude*." *Id.* In support, Petitioner reproduces the following excerpt of the parent '195 patent prosecution history:

> "a unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way - ***moving all minority carriers in the same direction*** because of the unidirectional drift due to the existence of the electric field... ***Depending on the particular slope*** of the graded concentration of dopant, all minority carriers ***are either swept 'down'*** (from the surface layer to the substrate) ***or 'up'*** (from the substrate to the surface layer)."

Id. (quoting Ex. 1002, 289) (emphases by Petitioner).

Petitioner further contends that "PO falsely claims Applicant argued [during] prosecution that aid the movement was an "additional parameter" beyond the dopant gradient." . . . In actuality, Applicant explicitly stated that the graded dopant concentration inherently creates the field that aids movement." Pet. Reply 9 (citing PO Resp. 19–20). In support, Petitioner reproduces the following excerpt of the parent '195 patent prosecution history:

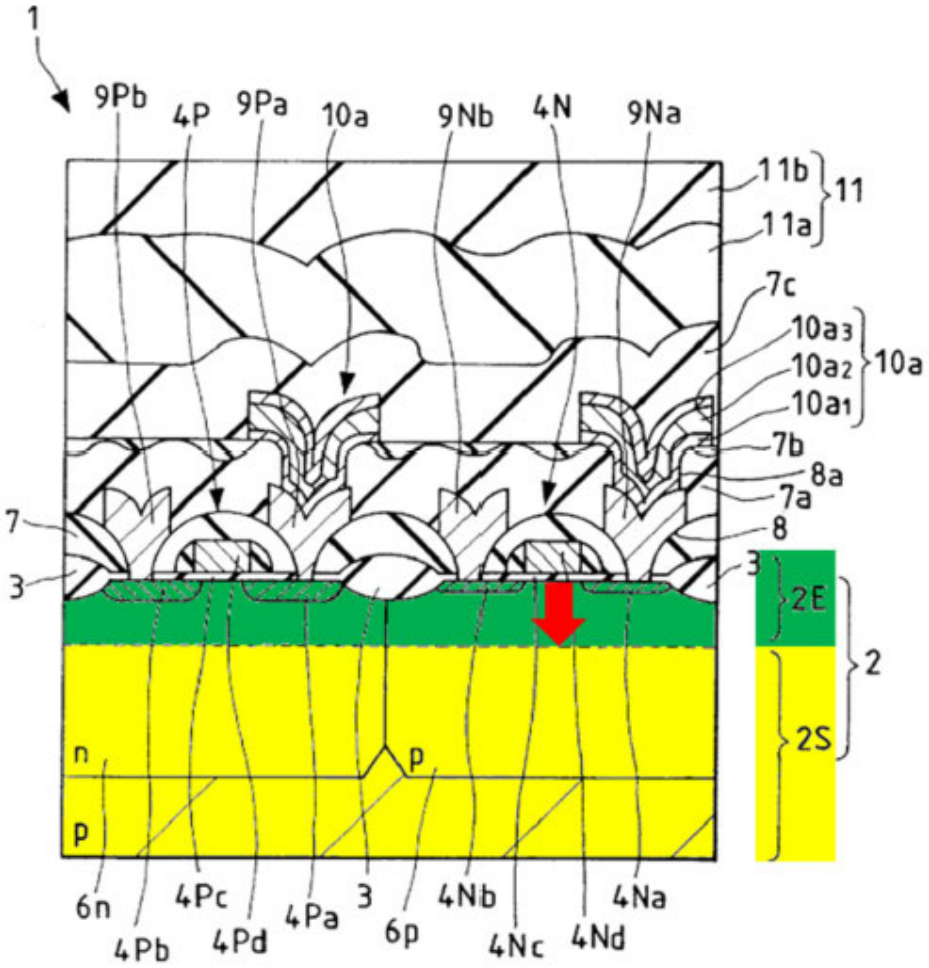
> "the graded dopant concentration itself creates a 'built-in' electrical field that forces the movement of carriers into a particular direction … [and] ***this inherent 'built-in' unidirectional electric field is the additional parameter*** for ensuring that all minority carriers are being moved in one direction ***and which parameter the Office Action deemed to be missing from the disclosure***."

Id. (quoting Ex. 1002, 289–90) (bold emphasis by Petitioner)).

Kawagoe's Carrier Movement

Petitioner contends that Patent Owner's "argument that Kawagoe solely '*inhibits* carrier movement' contradicts its literal text." Pet. Reply 16 (citing PO Resp. 16). Petitioner argues that "Kawagoe contains literal teachings that 'electrons produced by the α-ray are ***attracted*** to the substrate body 2S' and "[t]his is enough to render obvious 'aid the movement.'" *Id.* at 17 (quoting Ex. 1007, 16:7–9 (emphasis by Petitioner); citing Ex. 1055, 122:1–123:7). Petitioner directs our attention to an annotated reproduction of Kawagoe's Figure 16. *See id.* at 15–16.

Figure 16 of Kawagoe, annotated by Petitioner, is reproduced below.



Annotated Figure 16 depicts the direction of electron movement. Pet. Reply 16. According to Petitioner, parsing Kawagoe's teaching that "electrons produced by the α-ray are attracted to the substrate body 2S," means that "electrons will be attracted to the substrate body 2S (yellow) which means that that they exist outside the substrate body 2S (*i.e.*, epitaxial layer 2E (green)) to be attracted to it (red arrow)." *Id.* at 15–16 (quoting Ex. 1007, 16:7–9). Petitioner further contends that Kawagoe "states that its objective is to reduce the influence of α-rays by including a graded dopant concentration 'from the surface of the epitaxial layer 2E, so that the

influence to be caused by the carriers (or electrons) due to the α-ray is lowered.'" *Id.* at 16 (citing Ex. 1007, 16:2–7; Ex. 1054 ¶ 12).

Carriers in Kawagoe's Active Region

Petitioner contends Patent Owner's "argument that Kawagoe excludes α-rays generating electrons near the surface is wrong." Pet. Reply 15. According to Petitioner, "Kawagoe teaches: 'electrons produced by the α-ray are attracted to the substrate body 2S.'" *Id.* (citing Ex. 1007, 16:7–9). Further, Petitioner contends, Patent Owner's "argument is also based on the faulty premise that α-rays will not hit Kawagoe's p-well 6p to generate electrons. Nothing in Kawagoe (or other prior art) supports this extreme position." *Id.* at 16.

iii. Analysis of Arguments

We have considered the cited evidence, including expert testimony, and the parties' arguments pertaining to the limitations of claims 1and 21 that are in dispute. Below, we set forth our findings and conclusions as to those disputed issues.

Magnitude of Slope of Graded Dopant Concentration

With regard to the parties' arguments concerning the "at least one graded dopant concentration to aid carrier movement" limitation, we briefly summarize the prosecution of the parent '195 patent. During prosecution, the Examiner rejected claims under the pre-AIA version of 35 U.S.C. § 112, first paragraph and found that "movement of minority carriers is affected by multiple forces and fields" and that "it does not appear that simply the presence of 'a unidirectional drift field' in itself can achieve 'drawing all minority carriers from said surface layer to said substrate.'" Ex. 1002,

269–70, *see id.* at 289. The Applicant responded with the following argument:

> [A] unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way - moving all minority carriers in the same direction because of the unidirectional drift due to the existence of the electric field. *See* "Physics and Technology of Semiconductor Devices," A.S. Grove, pp. 224–225, John Wiley and Sons, Inc., New York, 1st Edition 1967 ("This same electric field will then be of such direction as to aid the motion of injected holes. Thus the injected minority carriers will now move not only by diffusion but also by drift due to the existence of this electric field."). Depending on the particular slope of the graded concentration of dopant, all minority carriers are either swept "down" (from the surface layer to the substrate) or "up" (from the substrate to the surface layer). *See* Applicant's Figs. 5(b) and 5(c).

Id. at 289. Applicant further argued that the Examiner's argument that the simple presence of a "graded dopant concentration" "does not appear to ensure (without knowing other parameters of the device) that it will draw 'all' minority carriers"

> 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 dopant. With regard to the existence of a "built-in" electric field created by a graded dopant density, . . . *this inherent "built-in" unidirectional electric field is the additional parameter for ensuring that all minority carriers are being moved in one direction* and which parameter the Office Action deemed to be missing from the disclosure.

Id. at 289–90 (emphases added). Also, "without conceding [its] position on this issue," Applicant amended the claims to no longer require "drawing all minority carriers," and instead, to require that the claimed "unidirectional

drift field" created by the "graded concentration of dopants" "aid the movement of minority carriers."[19] *Id.* at 290.

We determine that the statements made by Applicant during prosecution of the '195 patent were clear, unambiguous, and indicate that one of ordinary skill in the art need not know whether there are other "forces and fields" in an electronic device, as the mere presence of a graded dopant concentration creating a "unidirectional drift field," facing in the appropriate direction, will "aid the movement of minority carriers from" the surface layer to the substrate. Ex. 1002, 270, 289–90. The public was entitled to rely on these clear and unambiguous statements when considering the scope of the challenged claims. *Hockerson-Halberstadt, Inc. v. Avia Group Int'l, Inc.*, 222 F.3d 951, 957 (Fed. Cir. 2000) ("The prosecution history constitutes a public record of the patentee's representations concerning the scope and meaning of the claims, and competitors are entitled to rely on those representation when ascertaining the degree of lawful conduct, such as designing around the claim invention.").

Based on the complete record developed during trial, Applicant's statements during prosecution of the '195 patent, along with the disclosures of the '195 patent specification, support a determination that a graded dopant concentration is enough to teach aiding carrier movement in a particular direction. In that regard, we observe that Applicant "did not provide the

[19] The examined claims of the application that issued as the '195 patent generally recited "a unidirectional drift field drawing all minority carriers from said surface layer to said substrate." Ex. 1002, 250 (emphasis omitted). Patent Owner amended the claims of the '195 patent application to recite "maintain[ing] a single static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate." *Id*. at 286 (emphasis omitted).

type of detail in" the '195 patent specification that Patent Owner "now argues is necessary in [the] prior art references." *In re Epstein*, 32 F.3d 1559, 1568 (Fed. Cir. 1994).

We also find unavailing Patent Owner's arguments pointing to a portion of the specification that discloses what it regards as a specific dopant concentration. *See* PO Resp. 14–15 (quoting Ex. 1001, 2:66–3:15)). The '014 patent discloses that

> [t]he *relative* doping concentrations of emitter and collector regions varies from 10^{18} to $10^{20}/cm^3$, whereas the base region is 10^{14} to $10^{16}/cm^3$ depending on the desired characteristics of the BJT. In graded base p-n-p transistors, the donor dopant concentration may be 10 to 100× at the emitter-base junction, *relative* to the base-collector junction (1×). The gradient can be linear, quasi linear, exponential or complimentary error function. The *relative* slope of the donor concentration throughout the base creates a suitable aiding drift electric field, to help the holes (p-n-p transistor) transverse from emitter to collector.

Ex. 1001, 2:66–3:9 (emphases added). All of the disclosures of doping concentrations are relative. *Id.* Further still, these concentrations are set forth with respect to a bipolar junction transistor (BJT) that is not encompassed by independent claims 1 and 21. The background of the '014 patent discloses that, in BJTs, the graded dopant concentration moves carriers from emitter to collector, that is, *within* the active region. *See id.* at 1:50–64, Fig. 1. In contrast, claims 1 and 21 require a graded dopant concentration to aid movement of carriers *away* from the active region to the substrate. *See id.* at 4:49–5:7, 6:4–33.

Claims 1 and 21 do not require aiding the movement of any particular number of carriers, let alone a need to move all the carriers. *See* Ex. 1001, 4:49–5:7 6:4–33.

In its Sur-reply, Patent Owner argues that

> [t]he 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." . . . . The type of claim does *not* turn on whether the claim is an apparatus or a method claim . . . . Rather, it "depend[s] on the claim language," since "differences exist between apparatus claims."

PO Sur-reply 11 (quoting *INVT SPE LLC v. Int'l Trade Comm'n*, 46 F.4th 1361, 1371–72 (Fed. Cir. 2022)). According to Patent Owner, "[w]hen, 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." *Id.* at 12 (citing *INVT*, 46 F.4th at 1371). Patent Owner further argues that Petitioner, in advancing a different view, "relies on misleading quotes from *INVT*'s predecessor" case, *ParkerVision*, 903 F.3d at 1361, "to dismiss [Patent Owner's] arguments as 'unsupported.'" *Id.* (quoting Pet. Reply 4). According to Patent Owner, "[t]he 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," whereas, in Patent Owner's view, the claims at issue in this review, by contrast, "are clear that 'aid[ing] carrier movement' can only be achieved by a [graded dopant concentration]." *Id.* (second and third alterations by Patent Owner). Further, Patent Owner argues, "[t]here is no 'different structure' that can 'perform the claimed function'" at hand. *Id.* Patent Owner concludes, on that basis, "Petitioner erroneously suggests that the 'claims are directed to a device capable of aiding carrier movement (as opposed to requiring movement).'" *Id.* at 13 (citing Pet. Reply 3).

We agree with Petitioner that claims 1 and 21 are not method claims. In *ParkerVision*, the Court reiterated that "apparatus claims cover what a device *is*, not what a device *does*." *ParkerVision*, 903 F.3d at 1361 (citing *Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F.2d 1464, 1468 (Fed. Cir. 1990)). That is, to effectively challenge claims 1 and 21, Petitioner must show that "the reference discloses an apparatus that is reasonably capable of operating so as to meet the claim limitations, *even if it does not meet the claim limitations in all modes of operation*." *Id.* (emphasis added).

Therefore, Petitioner must show "at least one graded dopant concentration" in either or both of the first and second active regions that is *capable* of "aid[ing] carrier movement from the first and second active regions to an area of the substrate where there are no active regions." Ex. 1001, 4:64–67. We are persuaded Petitioner has done so by showing that Kawagoe discloses a graded dopant concentration with a slope, in a particular direction, in Figures 16 and 17 of Kawagoe, that not only is reasonably capable of moving, ***but actually does*** move, carriers in the claimed direction. At least for that reason, moreover, Patent Owner's arguments about the *INVT* decision are unavailing.

As to Patent Owner's arguments that "two District Courts have previously agreed with [Patent Owner] that not *all* doping gradients aid carrier movement." (PO Resp. 17), we do not agree. We discern no finding in the WDTX Markman Order or the EDTX Markman Order that one must quantify the magnitude of the field in order to know if the electric field will "aid the movement of minority carriers." *See* Exs. 2074, 2075. The courts were not addressing the same argument raised by Patent Owner in this proceeding.

Rather, the court in the WDTX Markman Order addressed whether the term "graded dopant concentration" is indefinite and the court in the EDTX Markman Order addressed the construction of "a single drift layer . . . having a graded concentration of dopants . . . said drift layer further having a first static unidirectional drift field," as recited in claim 1 of the '195 patent. *See* Ex. 2074, 32–41; Ex. 2075, 10–17. The WDTX Markman Order can reasonably be interpreted to require only that the graded dopant concentration be sufficiently graded to create a "static unidirectional electric drift field," as recited in claim 1 of the '195 patent, which, as the Applicant argued during prosecution and Patent Owner argued in its claim construction brief before the Western District of Texas, would "aid in the movement of minority carriers." Ex. 2074, 39–40; Ex. 1030, 35 ("a [person of ordinary skill in the art] would have readily recognized that when a 'static unidirectional electric drift field' is present that it aids the movement of minority carriers. If it isn't present, then it doesn't."), 37 ("The intrinsic record consistently confirms that the electric fields aid the movement of the carriers.").

In the EDTX Markman Order, the court addressed the question of whether the graded concentration of dopants could both increase and decrease, rejected the defendant's suggestion that the '195 patent prosecution history demonstrates that "the slope must be only increasing or only decreasing to maintain a unidirectional drift field," and found that Applicant affirmatively argued during prosecution "that a graded dopant concentration will provide a unidirectional electric drift field to move the minority carriers in a single direction." Ex. 2075, 15–16. Thus, contrary to Patent Owner's arguments, the Court's conclusion in the EDTX Markman Order regarding the scope of the claims appears consistent with both the

Applicant's assertion during prosecution and Petitioner's arguments in this proceeding, i.e., that "a graded dopant concentration will provide a unidirectional electric drift field to move the minority carriers in a single direction." *Id.* at 16.

Patent Owner's position in its claim construction brief before the Western District of Texas is more on point: "Electric drift fields are a well-known phenomenon that cause carriers to move, and a POSITA would have readily recognized that when a 'static unidirectional electric drift field' is present that it aids the movement of the minority carriers. If it isn't present, then it doesn't." Ex. 1030, 35. Patent Owner's position is also that "[t]he drift field points to one direction and charge carriers, when free to move, respond to the drift field by moving in *one direction or the other depending on their charge polarity*." *Id.* at 36 (emphasis added) (citation omitted). More particularly, Patent Owner contends in its briefing that

> Defendants argue that the claims do not recite a range of doping, a particular doping profile, or a particular result. But this is not the test for indefiniteness. While the claims require that the graded dopants create an electric field that aids movement of the carriers, *they do not require a specific range of doping, a particular doping field, or a particular result, and this information is not necessary to understand the scope of Dr. Rao's invention*.

Id. at 37 (emphasis added). Patent Owner's arguments in this proceeding are unavailing and are inconsistent with positions taken in related litigation.

Accounting for Additional Forces

Patent Owner contends that "Dr. Campbell specifically identified" additional forces, including "temperature, capacitance effects at the PN junction, and imperfections in the silicon crystal," that determine carrier movement. PO Resp. 11 (citing Ex. 2085, 34:15–36:19, 39:8–12).

Patent Owner further argues that its own witness, Dr. Glew, identified "the inherent resistance of silicon" as another force that "affects carrier movement," representing "another factor Dr. Campbell fails to address." *Id.* at 14 (citing Ex. 2057 ¶¶ 54, 56).

Petitioner counters that, although Dr. Campbell recognized during cross-examination "that other factors theoretically could have influence on carrier movement," that testimony does not undercut his well-supported opinion that "an electric field oriented downward will push minority carriers away from the surface." Pet. Reply 13 (citing Ex. 1003 ¶ 32). Dr. Campbell explains, and we agree, that "an electric field must have a direction and have a magnitude to influence a carrier (*e.g.*, an electron.)" *Id.* (citing Ex. 2058, 34:1–14). "This is basic physics: an electron needs force applied upon it to drift and the stronger the electric field, the stronger the force." *Id.* (citing Ex. 1054 ¶¶ 4, 5). According to Petitioner, Patent Owner's witness, Dr. Glew, acknowledges "that a graded dopant concentration will create a drift field to aid carrier movement." *Id.* at 13–14 (citing Ex. 2057 ¶ 33).

Moreover, we find persuasive Petitioner's arguments and evidence that none of the "other supposed 'forces'" identified by Patent Owner, in fact, "counteract the dopant gradient's drift field." Pet. Reply 14. In particular, we are persuaded that "[r]esistance and temperature," and "crystalline imperfections" "are not forces at all," none of which "would counteract the force provided by the graded dopant concentration." *Id.* (citing Ex. 1055, 71:11–23, 79:15–81:5, 86:7–89:21).

According to Petitioner, "[t]his leaves the force introduced by the P-N junction capacitance as the only factor that—theoretically—could affect the direction of carrier movement." Pet. Reply 14. But "P-N junction capacitance," of course, "exists in every P-N junction, including those

junctions disclosed in the" challenged patent. *Id.* (citing Ex. 1001, Fig. 5(b)). Yet, as Petitioner aptly points out, the '014 patent and prosecution history do not refer to any impact of such capacitance on the drift field created by the dopant gradient, much less indicate it should be accounted for in relation to drift field created by the dopant gradient. *Id.* at 14–15.

Stated somewhat differently, even if we accept that "the force introduced by the P-N junction capacitance" theoretically "could affect the direction of carrier movement" (*see* Ex. 2058, 35:6–36:19), we agree with Petitioner that "the '014 Patent and prosecution history of it says ***nothing*** about such capacitance, much less (1) attributes any significance to it, (2) suggests that it might counteract the drift field created by the dopant gradient, or (3) claims the capacitance as a problematic force" (Pet. Reply 14–15). *See generally* Ex. 1001. In essence, Patent Owner asks the Board to hold the prior art (and Dr. Campbell's opinions about the prior art) to a higher standard of disclosure than is provided in the challenged patent. *See In re Epstein*, 32 F.3d at 1568 ("appellant did not provide the type of detail in his specification that he now argues is necessary in prior art references"). The prior art (and Dr. Campbell's testimony about it) provides the type of detail commensurate with the level of detail provided in the '014 patent specification.

Taking account of the arguments and evidence advanced by both parties, we agree with Petitioner that the claims "merely require that the claimed 'graded dopant concentration' 'aid carrier movement'—***not*** that it generate a field to overcome all other theoretical forces" and find it particularly relevant that none of these theoretical forces "are identified [in] the specification, prosecution history, or the cited prior art." Pet. Reply 4.

We further agree that "the field effect from the P-N junctions requires an applied voltage for electrons to flow . . . , which the claims do not require," while "[t]he graded dopant concentration is ***static***—always present regardless of the device's power state." Pet. Reply 15 (citing Ex. 2058, 35:10–17; Ex. 1059, 18–20);[20] *see* Ex. 1002, 128 ("the claimed invention relates to . . . devices which include graded dopant concentrations in regions capable of providing a localized drift electric field without the application of an external potential"), 289–90. We further agree with Petitioner that Patent Owner's own cited evidence (*see* PO Resp. 12 (citing Ex. 2030))

[20] Patent Owner seeks to exclude Exhibit 1059 because it bears no date and includes "two seemingly disjointed references," namely, a "textbook chapter" and "an excerpt from a slide presentation." Mot. Exclude 2. Petitioner cites Exhibit 1059 for a basic technological concept of semiconductor physics that is not disputed adequately, if at all, by Patent Owner. We need not and, therefore, do not rely on Exhibit 1059. Even if we set aside Exhibit 1059, Petitioner makes out adequately the asserted technological concept. Pet. Reply 15; Ex. 2058, 35:10–17 (cross-examination testimony of Dr. Campbell). Alternatively, we take administrative notice that the concept would have been known in the field of semiconductors at the time of the invention, as evidenced by Applicant's own clear assertions to the Office. Ex. 1002, 128 (Patent Owner's assertions, during prosecution, that "the claimed invention relates to . . . devices which include graded dopant concentrations in regions capable of providing a localized drift electric field without the application of an external potential"); *see* Pet. 12 ("At the time of the alleged invention, Patent Owner represented that is was well-known that a graded dopant concentration creates a static unidirectional electric drift field."); Pet. Reply 9 (Applicant, arguing during prosecution, that a "graded dopant concentration itself creates a 'built-in' electrical field that forces the movement of carriers into a particular direction," which "depends solely on the slope of the graded concentration of dopant.") (quoting Ex. 1002, 289–90) (prosecution history, underlining in original)).

"recognizes that a graded dopant profile—even with capacitive effects—provides an electric field." Pet. Reply 15 (citing Ex. 2030, 7:4–7).

In summary, the only force that could possibly affect the direction of carrier movement, P-N junction capacitance, is present only when a voltage is applied to the claimed semiconductor device. Even assuming, *arguendo*, that the specification provided any hint or suggestion that P-N junction capacitance must be accounted for, which it does not, claims 1 and 21 encompasses situations in which no voltage is applied and P-N junction capacitance does not affect the drift field generated by claimed graded dopant concentration.

For the reasons set forth above, based on the complete record developed during trial we find that Petitioner persuasively demonstrates that Kawagoe teaches or suggests the disputed "graded dopant concentration to aid carrier movement" limitations of claims 1 and 21.

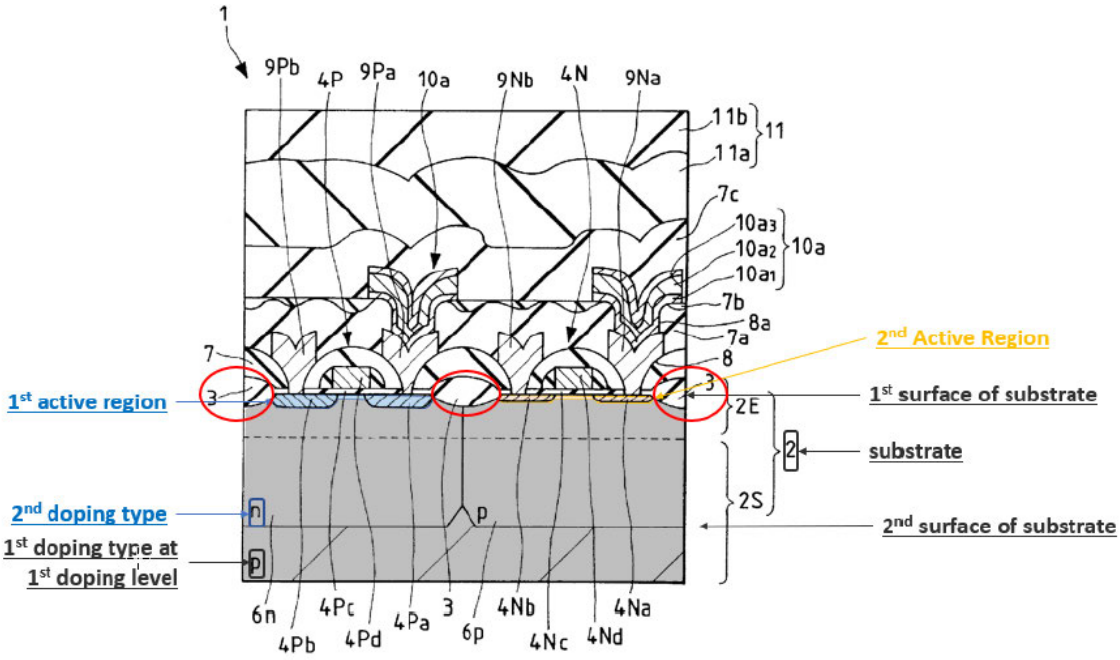
c. Conclusion with Respect to Claims 1 and 21

Based on the complete record developed during trial, we determine that Petitioner persuasively demonstrates that Kawagoe teaches or suggests every limitation of claims 1 and 21. And, as discussed above in Section III.D, we give little weight to Patent Owner's evidence of objective indicia of nonobviousness, but even if it was given more weight, it would not overcome Petitioner's strong case of obviousness. Accordingly, we determine that Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 1 and 21 would have been obvious over Kawagoe.

3. Analysis—Dependent Claims 6 and 27

Dependent claims 6 and 27 further requires "wherein the first active region and second active region of the at least one semiconductor device are each separated by at least one isolation region." Ex. 1001, 5:22–24, 6:50–52.

Figure 16 of Kawagoe, annotated by Petitioner, is reproduced below.



Annotated Figure 16 depicts first active region (blue), second active region (yellow) and field insulating film 3 (no color, circled in red). *See* Pet. 34. Petitioner contends that field insulating film 3 regions of Kawagoe is an isolation region that separates the first and second active regions. *See id.* at 33 (citing Ex. 1007, 8:46–54); Ex. 1003 ¶¶ 187, 188, 469).

Patent Owner contends Petitioner fails to appreciate that region 4Na and 4Nb "are made as deep as about 0.5 μm and ***formed in the range of thickness of the epitaxial layer 2E***." PO Resp. 31 (quoting Ex. 1007, 9:3–6; citing Ex. 1007, 8:66–67). Thus, according to Patent Owner, "a POSITA would have understood that the first and second active regions extend to

about the depth of the epitaxial layer 2E and abut each other laterally and therefore "are not separated by Kawagoe's field insulating film 3." *Id.* at 31–32.

As depicted in Figure 16, field insulating film 3 physically separates the first and second active regions. Ex. 1007, Fig. 16. As pointed out by Petitioner, the claims do not specify the extent of separation of the isolation, and does not require the isolation region to separate the two active regions along their whole depth, as suggested by Patent Owner. *See* Pet. Reply 17. To the extent the isolation region must be in between the first and second active regions at all points and field insulating film 3 is not so positioned, Petitioner also demonstrates that a "channel stopper region" is formed below the field insulating film and is used to ensure that errant carriers do not migrate from one transistor to another. *See id.* at 18 (citing Ex. 1007, 8:43–45).

In view of the foregoing, and based on the complete record developed during trial, we determine that Petitioner persuasively demonstrates that Kawagoe teaches or suggests the limitations of dependent claims 6 and 27. Therefore, we determine that Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 6 and 27 would have been obvious over Kawagoe.

4. Analysis—Dependent Claims 3–5, 7–9, 13, 15–17, 20, 23–26, and 28

Claims 3–5, 7–9, 13, 15–17, 20, 23–26, and 28 depend from either independent claim 1 and 21. Petitioner identifies where Kawagoe teaches or suggests every limitation of claims 3–5, 7–9, 13, 15–17, 20, 23–26, and 28. *See* Pet. 31–38, 40–41. We have reviewed Petitioner's arguments and find that it is fully supported by the cited evidence. *See id.* Patent Owner does

not address Petitioner's contentions with respect to claims 3–5, 7–9, 13, 15–17, 20, 23–26, and 28, apart from its arguments addressing independent claim 1 and 21. *See* PO Resp. 20–26.

Based on the complete record developed during trial, we determine that Petitioner persuasively demonstrates that Kawagoe teaches or suggests every limitation of claims 3–5, 7–9, 13, 15–17, 20, 23–26, and 28. Accordingly, we determine that Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 3–5, 7–9, 13, 15–17, 20, 23–26, and 28 would have been obvious over Kawagoe.

5. Conclusion

For the reasons set forth above, Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 1, 3–9, 13, 15–17, 20, 21, and 23–28 would have been obvious over Kawagoe.

F. Patentability Challenge Based on Onoda

Petitioner contends the subject matter of claims 1, 3–9, 13, 15–17, 20, 21, and 23–28 would have been obvious over Onoda. *See* Pet. 41–76.

1. Overview of Onoda (Exs. 1042, 1043)

Onoda is titled "Semiconductor Integrated Circuit Device, Nonvolatile Semiconductor Storage Device, and Manufacturing Method" and describes "a nonvolatile semiconductor storage device with improved latch-up resistance and punch-through breakdown voltage and improved junction breakdown voltage between the well regions and the semiconductor substrate." Ex. 1042, codes (54), (57). Onoda "relates to a semiconductor integrated circuit device, to a nonvolatile semiconductor storage device, and to methods of manufacturing thereof, and, in particular, relates to a

nonvolatile semiconductor storage device wherein a triple-well structure is formed in an epitaxial substrate." *Id.* ¶ 1.

Figure 8 of Onoda is reproduced below.

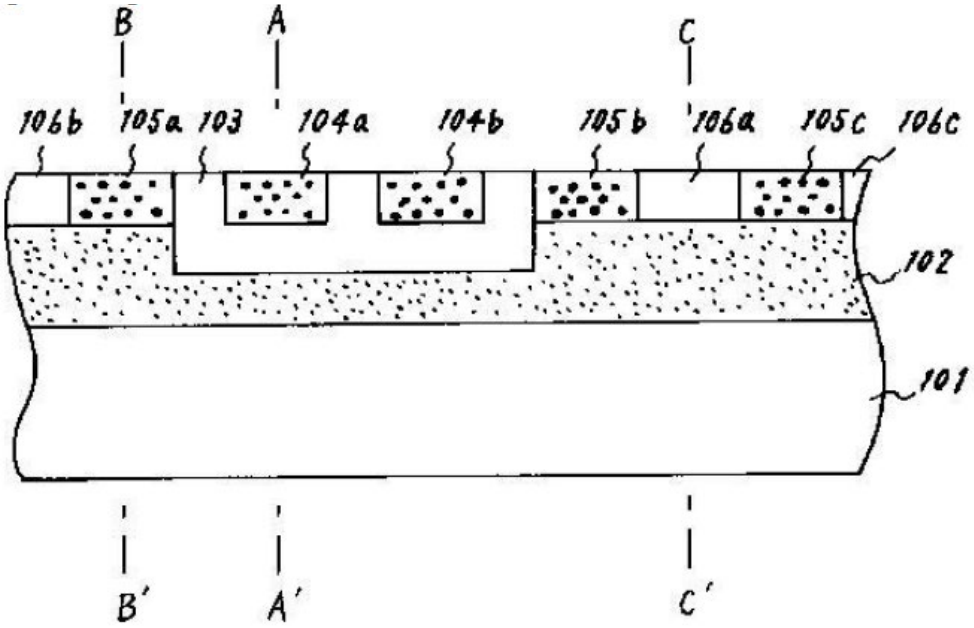


Figure 8 "is a cross-sectional drawing illustrating, in step order [in conjunction with Figures 4–7], manufacturing of a semiconductor substrate 100." "that is applied to a flash memory." Ex. 1042 ¶ 46, p. 28, 1:29–32. Figure 8 depicts "first semiconductor layer 101, which comprises a heavily-doped P-type silicon substrate (silicon wafer) with a dopant concentration of 1 x 10^{19}/cm^3" (*id.* ¶ 46) and "lightly-doped P-type second semiconductor layer 102 wherein epitaxial layer 102a, as a whole, is between 1 x 10^{16} and 1 x 10^{18}/cm^3" (*id.* ¶ 47). Figure 8 further depicts "N-type first well region 103 with a depth of about 3 μm and a dopant concentration of between 1 x 10^{15} and 1 x 10^{18}/cm^3." *Id.* ¶ 48. Also shown in Figure 8 are boron implantation layers 104A, 104B, 105A, 105B, and 105C, and phosphorus implantation layers 106A through 106C. *See id.* ¶ 49.

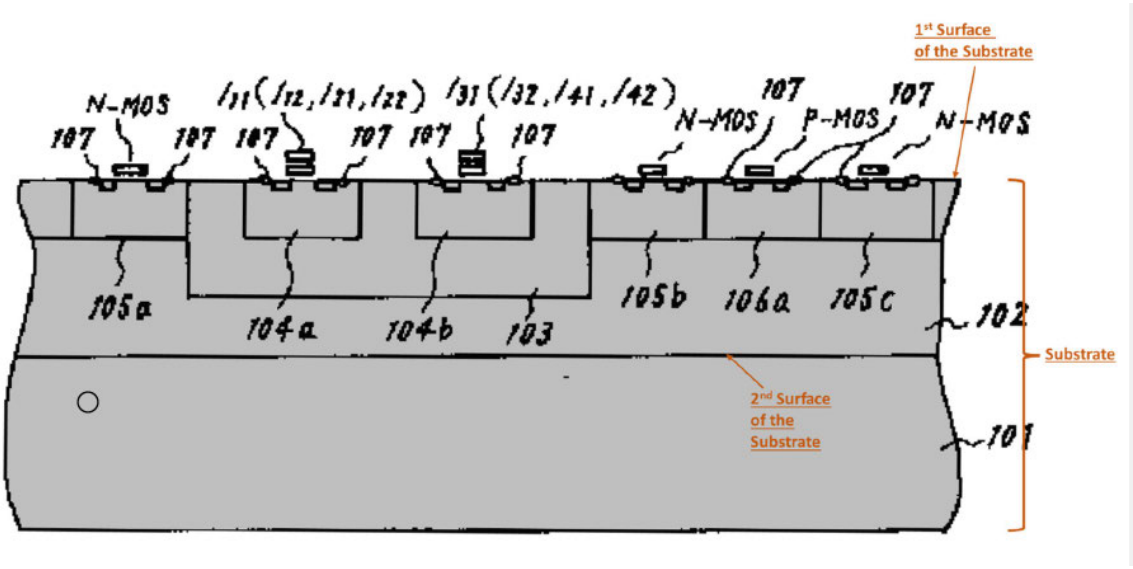
2. Analysis—Claim 1 and Independent Claim 21

a. Undisputed Limitations of Claims 1 and 21

Claims 1 and 21 recite "An electronic system, [the system] comprising: at least one semiconductor device, the at least one semiconductor device including."[21] Ex. 1001, 4:49–51, 6:4–6. Petitioner contends that Onoda teaches a nonvolatile semiconductor storage device" that constitutes an electronic system. *See* Pet. 43 (citing Ex. 1042, code (57), claims 1–12, ¶¶ 6–17; Ex. 1003 ¶ 413).

Claims 1 and 21 also recite "a substrate of a first doping type at a first doping level having a surface." Ex. 1001, 4:52–53, 6:7–8. Petitioner contends that Onoda teaches this limitation. *See* Pet. 44–45.

Figure 3 of Onoda, annotated by Petitioner, is reproduced below.



Annotated Figure 3 depicts semiconductor substate 100 encompassing layers 101 and 102 and annotated to show a substate, a 1st surface of the substrate, and a 2nd surface of the substrate below the 1st surface of the

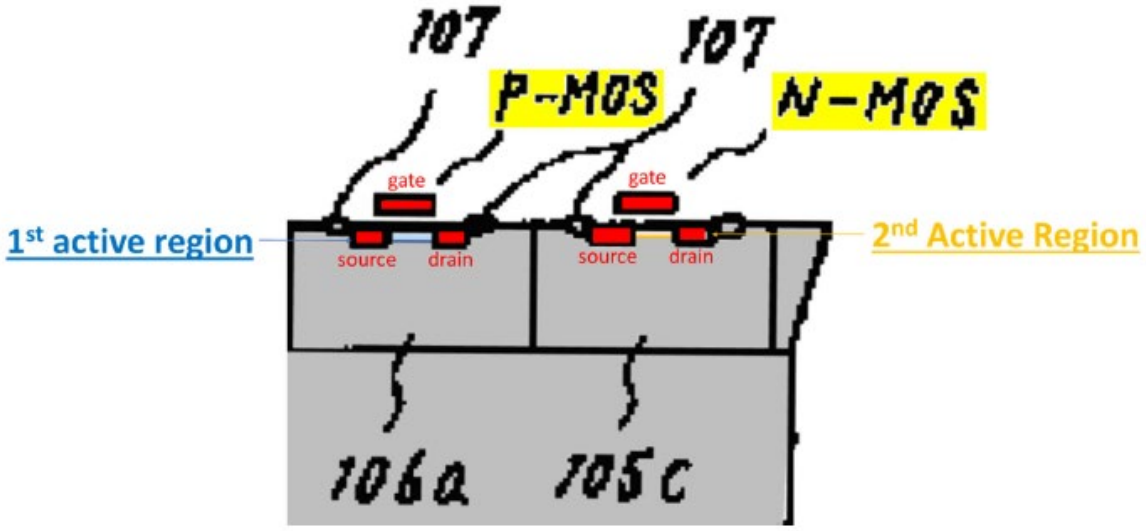
[21] We use bracketed language to show the differences between claims 1 and 21.

substrate. *See* Pet. 44. Petitioner asserts that the semiconductor substate 100 is doped to be p-type, specifically made of first semiconductor layer 101 made of heavily doped p-type silicon and p-type doped semiconductor layer 102 on top of first semiconductor layer. *See id.* at 44–45 (reproducing Ex. 1042, Figs. 4–5 (with Petitioner's annotations added); citing Ex. 1042 ¶¶ 41, 43; Ex. 1003 ¶¶ 72–78, 282).

Claims 1 and 21 also recite "a first active region disposed adjacent the surface [of the substrate] with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed [in the surface thereof]." Ex. 1001, 4:54–57, 6:9–13. Petitioner contends that Onoda discloses n-well regions 106a, 106b, 106c, that each have PMOS transistors that each have and active region. *See* Pet. 45–48 (reproducing Ex. 1042, Fig. 3 (with Petitioner's annotations added); Ex. 1008, 299 Figs. a), b) (with Petitioner's annotations added); citing Ex. 1042 ¶¶ 29, 41–45, 44; Ex. 1003 ¶¶ 85–87, 415). Petitioner further asserts that Onoda's first active region is formed within fourth well region 106a which is doped to be n-type. *See id.* at 48 (citing Ex. 1042 ¶¶ 42, 44).

Claims 1 and 21 also recite "a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed [in the surface thereof]." Ex. 1001, 4:58–62, 6:14–19. Petitioner contends that Onoda discloses a second active region formed in p-type wells 105a, 105b, 105c in which transistors can be formed. *See* Pet. 49 (reproducing Ex. 1023, Fig. 3 (with Petitioner's annotations added); citing Ex. 1042 ¶¶ 43, 44, claim 2; Ex. 1003 ¶¶ 88–91, 416).

An excerpt of Figure 3 of Onoda, annotated by Petitioner, is reproduced below.



Annotated Figure 3 of Onoda depicts p-well region 105c adjacent n-well region 106a, P-MOS transistor, and N-MOS transistor along with Petitioner's annotations showing a 1st active region, 2nd active region, and respective gates, sources, and drains. *See* Pet. 50. Petitioner asserts the second active region is part of p-type well 105c forming N-MOS transistor, and is adjacent the first active that is part of n-type well 106a forming P-MOS transistor. *See* Pet. 49–50 (citing Ex. 1043 ¶¶ 29, 44).

Claim 1 also requires "wherein at least some of the transistors form digital logic of the semiconductor device." Ex. 1001, 5:5–7. According to Petitioner, "Onoda discloses transistors that are formed in the first active region and the second active region, where the 'first active region' contains a P-MOS and the 'second active region' contains an N-MOS." Pet. 51; *see* Pet. 52 (reproducing and excerpt of Ex. 1042, Fig. 3 (with Petitioner's annotations added)).

Claim 21 also requires "wherein the graded dopant concentration is linear, quasilinear, error function, complementary error function, or any

combination thereof." Ex. 1001, 6:30–33. Petitioner contends that Onoda teaches several dopant gradient profiles for example Figure 11 that depicts a gradient that is quasi-linear or at least linear, and teaches a Gaussian distribution of dopants. *See* Pet. 74–75 (citing Ex. 1042 ¶ 53, Fig. 11; Ex. 1003 ¶¶ 442–43).

Patent Owner does not dispute Petitioner's contentions that Onoda teaches or suggests the aforementioned undisputed limitations of claims 1 and 21. *See* PO Resp. 26–28. Based on the complete record developed during trial, we determine that Petitioner persuasively demonstrates that Onoda teaches or suggests the aforementioned undisputed limitations of claims 1 and 21.

b. Disputed Limitations of Claims 1 and 21

Claims 1 and 21 recite:

> at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the [first and second active regions towards/surface to] an area of the substrate where there are no active regions; and at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface [towards/to] the area of the substrate where there are no active regions.

Ex. 1001, 4:63–5:5, 6:20–32.

Petitioner contends that Onoda discloses "a second active region is formed within p-well region 105c" and "that the well region has a doping profile that is downward graded and, consequently, the active region would have the same doping profile because it is formed within the well region." Pet. 52. According to Petitioner, "Onoda's FIG. 11 depicts the graded dopant profile across the p-type well regions 105a, 105b, 105c, which

constitutes the 'at least one graded dopant concentration' of the 'at least a portion of at least one of the first and second active regions.'" Pet. 53. Petitioner also contends that "FIG. 11 is a cross sectional slice (B-B) through the device depicted in FIG. 8, which is the same embodiment as FIG. 3." *Id.* (citing Ex. 1042 ¶¶ 41–45). According to Petitioner,

> the dopant concentration decreases as a function of depth through the third well region 105a (p-type) and the second semiconductor layer 102 (p-type). Then, at the point where the slice reaches the semiconductor layer 101, the dopant concentration increases. (*Id.* at [0052].). Moreover, a POSITA would have understood that third well regions 105b and 105c would have the same dopant profile as region 105a, because the composition of all three regions are identical.

Id. (citing Ex. 1042 ¶ 52; Ex. 1003 ¶¶ 98–100, 418); *see* Pet. 54–60 (reproducing Ex. 1042, Figs. 3, 8, 11 (with Petitioner's annotations added)); Ex. 1003 ¶¶ 94–117.

Petitioner further contends that Onoda discloses the p-well region 105c is adjacent to the first active region located near the top of the p-well region 105c, and the n-well region 106a is adjacent to the second active region located near the top of the n-well region 106a. *See* Pet. 60 (citing Ex. 1042 ¶¶ 41–45) *see* Pet. 61–62 (reproducing Ex. 1042, Figs. 3, 11 (with Petitioner's annotations added). According to Petitioner,

> FIG. 11 in Onoda discloses that the p-well region 105a in Onoda at least has a p dopant concentration decreases from the top surface of the p-well region 105a (the first surface of the substrate 100) into the well region 105a. (Onoda at [0052].) The p-well regions 105b and 105c have the same graded dopant concentration profile. As discussed above . . . this graded dopant region in the p-well region 105a, 105b or 105c drives electrons to the bottom of the respective well region towards the bottom of the substrate.

Pet. 61 (citing Ex. 1042 ¶ 52); *see* Pet. 61–62 (reproducing Ex. 1042, Figs. 3, 11 (with Petitioner's annotations added); Ex. 1003 ¶¶ 201–206).

i. Patent Owner's Arguments

Patent Owner contends that, as discussed with respect to the challenge based on Kawagoe, "the existence of a downward-sloping graded-dopant concentration alone is not sufficient to establish the 'aid the movement of minority carriers' claim limitation." PO Resp. 26–27 (citing PO Resp. §§ VI.A.2, VI.B.1). Patent Owner contends that

> Dr. Campbell admitted that only a "properly constructed" "electric field" "will push minority carriers." Nothing in the Petition explains how Onoda's field is "properly constructed" or analyzes the numerous factors that Dr. Campbell admits affect carrier movement (e.g. ***temperature, silicon imperfections, resistance, and slope***) . . . [T]here are a number of PN junctions in Onoda that, according to Dr. Campbell, create "substantial electric fields" which he failed to account. Since Dr. Campbell does not identify the net force acting on the carriers, or analyze the factors necessary to identify it, the Petition fails to show that the gradient aids carrier movement.

Id. at 27 (citing Ex. 1003 ¶ 33; Ex. 2058, 34:15–36:19; 39:8–12) (emphasis added). According to Patent Owner,

> Petitioner and Dr. Campbell did not take into account anything besides the existence of a downward-sloping concentration gradient in concluding that Onoda teaches the "aid carrier movement" limitations. Therefore, the Petition is based on an incorrect premise and fails to carry Petitioner's burden.

Id. at 28 (citing Pet. 52–63; Ex. 2057 ¶¶ 52–58).

ii. Petitioner's Reply

Petitioner contends that "Onoda teaches a graded dopant concentration from the surface layer to the substrate and a POSITA would have found it obvious that the graded dopant concentration would aid in the

movement of minority carriers." Pet. Reply 18 (citing Pet. 45–65). Petitioner further contends that Patent Owner's "argument that Petitioner must conduct an all-force-calculation is not supported by the claims, the prosecution history, or the governing law." *Id.* (citing Pet. Reply §§ II.A, II.B).

iii. Analysis of Arguments

We have considered the cited evidence, including expert testimony, and the parties' arguments pertaining to the limitations of claims 1 and 21 that are in dispute. For the same reasons set forth above in Section III.E.2., Patent Owner's arguments are unavailing. *See* PO Sur-reply 21–25 (relying on arguments that, in essence, rest on the faulty proposition that Onoda's graded dopant concentration is insufficient to make out "aid carrier movement" in the active region). No particular magnitude or specific numerical value of slope must be shown in order to satisfy the claims. Petitioner persuasively demonstrates that Onoda teaches the relative slope of graded dopant concentration to aid carrier movement. *See* Pet. 41–76 (and evidence cited therein). Our reasoning above, presented in the context of the patentability challenges based on Kawagoe, applies with equal force here.

In that regard, Patent Owner's arguments about the necessity to assess the effect exerted by numerous other factors on carrier movement (namely, "temperature, silicon imperfections, resistance, ***and*** slope") are unavailing. PO Resp. 27 (Board's emphasis). Patent Owner faults Dr. Campbell for not taking "into account anything besides the existence of a downward-sloping concentration gradient in concluding that Onoda teaches the 'aid the carrier movement limitations'" (*id.* at 28), but for reasons discussed above in

connection with the patentability challenge based on Kawagoe, we find Petitioner's counterviews on this point more persuasive.

A preponderance of the evidence supports Petitioner's counterview, moreover, that "an all-force-calculation is not supported by the claims, the prosecution history, or the governing law." Pet. Reply 18; *see* Pet. 12–15, 41–76 (Petitioner's well-supported arguments, including evidence that Onoda teaches a graded dopant concentration that would aid in the movement of minority carriers); *see* Pet. 56; Ex. 1003 ¶¶ 47, 103, 418 (identifying Patent Owner's plainly contradictory affirmations to the Office during prosecution of the parent '195 patent, where Patent Owner admitted "the graded-dopant concentration *itself* creates a 'built-in' electrical field" that "forces the movement of carriers" and, moreover, that "the resulting direction of the carrier movement depends *solely* on the slope of the graded concentration of dopant") (emphasis added).

Stated somewhat differently, the '014 patent and its prosecution history focus solely on slope. See Pet. 11–12 (and citations therein to '014 patent (Ex. 1001)); Ex. 1002, 289–90 (prosecution history). The '014 patent focuses on slope without any indication that "temperature, silicon imperfections," or "resistance" must be accounted for as forces affecting carrier movement. See PO Resp. 27. Here again, we decline to hold the disclosure of Onoda (and Dr. Campbell's testimony about that disclosure) to a higher standard than the disclosure of the challenged patent. See In re Epstein, 32 F.3d at 1568 ("[T]he Board's observation that appellant did not provide the type of detail in his specification that he now argues is necessary in prior art references supports the Board's finding that one skilled in the art would have known how to implement the features of the references.").

For the reasons set forth above, based on the complete record developed during trial Petitioner persuasively demonstrates that Onoda teaches or suggests the disputed "graded dopant concentration to aid carrier movement" limitations of claims 1 and 21. *See* Pet. 52–63.

c. Conclusion with Respect to Claims 1 and 21

Based on the complete record developed during trial, we determine that Petitioner persuasively demonstrates that Onoda teaches or suggests every limitation of claims 1 and 21. In addition, as discussed above in Section III.D, we give little weight to Patent Owner's evidence of objective indicia of nonobviousness, but even if it was given more weight, it would not overcome Petitioner's strong case of obviousness. Accordingly, we determine that Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 1 and 21 would have been obvious over Onoda.

3. Analysis—Dependent Claims 3–9, 13, 15–17, 20, and 23–28

Petitioner identifies where Onoda teaches or suggests every limitation of dependent claims 3–9, 13, 15–17, 20, and 23–28. *See* Pet. 63–76. We have reviewed Petitioner's arguments and find that it is fully supported by the cited evidence. *See id.* Patent Owner does not address Petitioner's arguments with respect to these dependent claims, apart from the arguments addressing independent claims 1 and 21. *See* PO Resp. 26–28.

Based on the complete record developed during trial, we determine that Petitioner persuasively demonstrates that Onoda teaches or suggests every limitation of dependent claims 3–9, 13, 15–17, 20, and 23–28. Accordingly, we determine that Petitioner demonstrates by a preponderance

of the evidence that the subject matter of dependent claims 3–9, 13, 15–17, 20, and 23–28 would have been obvious over Onoda.

4. Conclusion

For the reasons set forth above, Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 1, 3–9, 13, 15–17, 20, 21, and 23–28 would have been obvious over Onoda.

G. Patentability Challenge Based on Onoda and Nishizawa

Petitioner contends the subject matter of claims 1, 3–9, 13, 15–17, 20, 21, and 23–28 would have been obvious over Onoda and Nishizawa. *See* Pet. 76–82.

1. Overview of Nishizawa (Ex. 1046)

Nishizawa "relates to a semiconductor device, and more particularly to a semiconductor device such as an insulation-gate transistor which allows a high packing density integration and effects a good holding of memory contents and which does not make soft errors induced by alpha-particle irradiation." Ex. 1046, 1:21–29.

Figure 16 of Nishizawa is reproduced below.

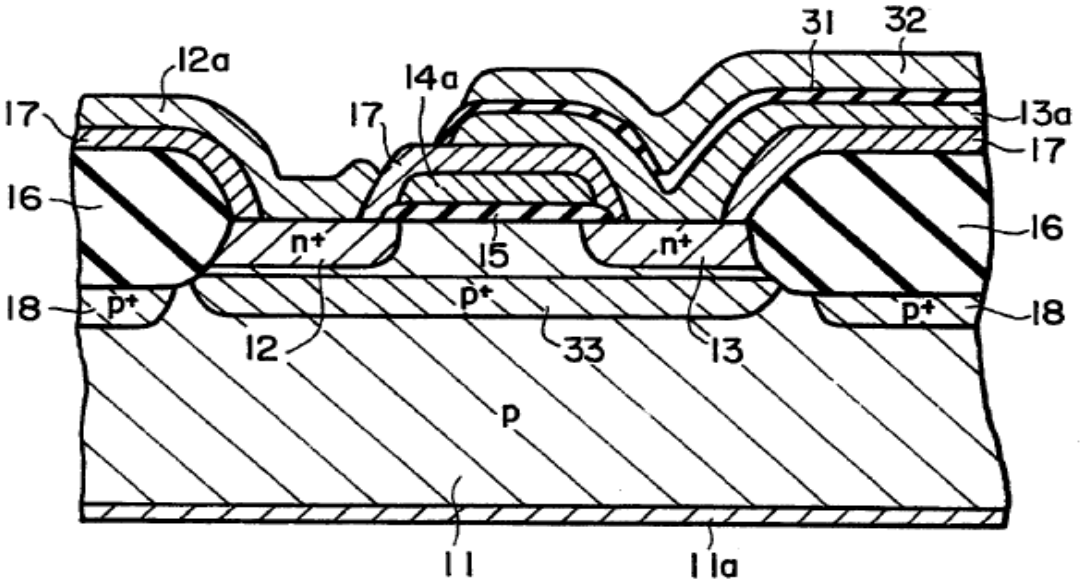


Figure 16 depicts a sectional view of the structures of dynamic random access memory ("d-RAM") cell. Ex. 1046, 8:25–26. The d-RAM cell of Figure 16 includes p-type substrate 11, substrate electrode 11a, n+ type regions 12, n+ type storage region 13, and p+ type buried region 33. *See id.* at 11:30–33, 17:40–47. Source electrode 12a and drain electrode 13a are made of a metal such as aluminum. *See id.* at 2:7–10. "Numeral 15 represents a gate oxide film, 16 a field oxide film, and 17 a PSG film." *Id.* at 2:6–7. "Numeral 18 represents a p+ type region which serves as a channel-stopper region for inhibiting the tendency of formation of a current channel between the field oxide film 16 and p type substrate 11." *Id.* at 2:10–13. "Numeral 14a represents a gate electrode made of p+ type polysilicon, 13a an n+ type polysilicon, 31 a thin oxide film, and 32 a metal electrode such as aluminum." *Id.* at 10:17–20.

2. Analysis—Claim 1 and Independent Claim 21

a. Motivation to Combine

Petitioner contends that "[a] POSITA would have been motivated to apply Nishizawa's teachings of minority carrier diffusion based on a downward sloping dopant gradient (*e.g.*, Nishizawa at 18:46–67) to Onoda's teachings of a downward sloping dopant gradient (e.g., Onoda at FIG. 11)." Pet. 78 (citing Ex. 1003 ¶¶ 138, 450). According to Petitioner,

> Both Nishizawa and Onoda disclose similar structures with a graded dopant, and while Onoda generally references known issues related to minority carrier movement (e.g., soft errors and latch-up), Nishizawa makes explicit the concept of using an electric field, deliberately created through a dopant gradient, to move minority carriers to a substrate.

Id. (citing Ex. 1046, 18:10–18). Petitioner asserts that a POSITA "would have been motivated to combine teachings of Nishizawa's explicit discussion of concepts to the structures described in Onoda as confirmation of Onoda's teachings" and "would have understood that such combinations of known prior art elements would yield expected results and, moreover, would have found it obvious to try such combinations." Pet. 78–79 (citing Ex. 1003 ¶¶ 138–13, 450).

Patent Owner does not dispute Petitioner's contentions that a person of ordinary skill in the art would have been motivated to combine the teachings of Onoda and Nishizawa. *See* PO Resp. 28–30.

Based on Petitioner's citations to Onoda, Nishizawa, and Dr. Campbell's testimony (Ex. 1003), we are persuaded Petitioner sets forth sufficient articulated reasoning with rational underpinning to support the conclusion that it would have been obvious to one of ordinary skill in the art to apply Nishizawa's teachings of minority carrier diffusion based on a

downward sloping dopant gradient to Onoda's teachings of a downward sloping dopant gradient as it would have been a combination of prior art element that would have yielded predictable results. *See* Pet. 76–79; *KSR*, 550 U.S. at 418.

b. Undisputed Limitations of Claims 1 and 21

Petitioner asserts that Nishizawa teaches the preamble of claims 1 and 21 based on Nishizawa's semiconductor device and disclosure of both memory and CMOS semiconductor devices. *See* Pet. 79 (citing Ex. 1046, code (57), 7:40–63, 15:27–52, Fig. 32; Ex. 1003 ¶¶ 138, 451), 81. Petitioner relies on its arguments addressing Onoda highlighted above in Section III.F. to address the undisputed limitations. *See* Pet 79 (citing Ex. 1003 ¶ 451), 81–82.

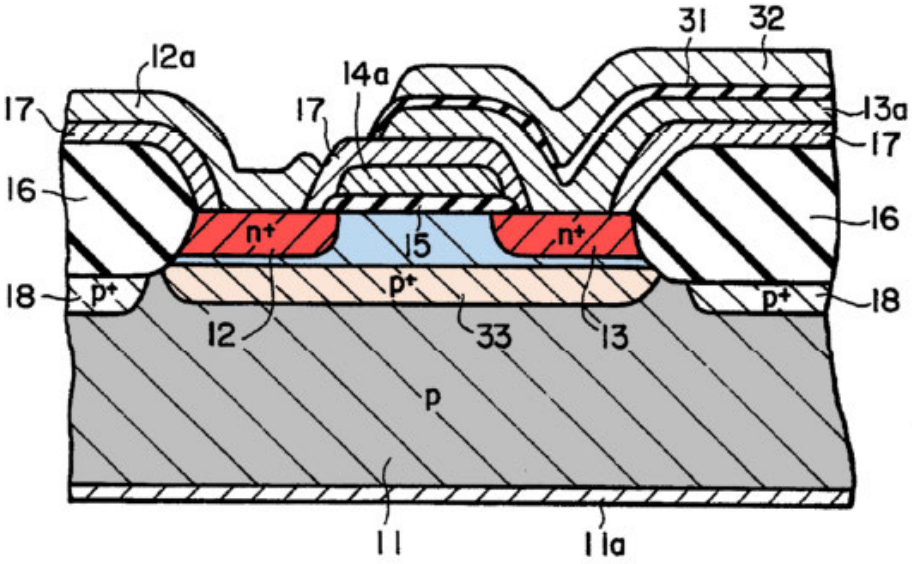
Patent Owner does not dispute Petitioner's contentions that the combination of Onoda and Nishizawa teaches or suggests the aforementioned undisputed limitations of claims 1 and 21. *See* PO Resp. 28–30. Based on the complete record developed during trial, we determine that Petitioner persuasively demonstrates that the combination of Onoda and Nishizawa teaches or suggests the aforementioned undisputed limitations of claims 1 and 21.

c. Disputed Limitations of Claims 1 and 21

Petitioner contends that "Onoda discloses multiple active regions whose dopant concentrations have a downward gradient, which a POSITA would have recognized as providing an electric drift field in the active region to aid the movement of minority carriers from the first surface to the second surface of the substrate (substrate 100)." Pet. 79–80 (citing Ex. 1003 ¶¶ 143–146, 452–453). Petitioner further contends that "Nishizawa makes

explicit that the downward gradient aids in the movement of carriers to the substrate." *Id.* (citing Ex. 1046, 18:47–50, 19:1–19, 18:10–18).

Figure 16 of Onoda, annotated by Petitioner, is reproduced below.



Annotated Figure 16 depicts p-type substrate 11 and substrate electrode 11a. Petitioner annotates the device to highlight in red source and drain n+ regions 12 and 13, surface region 15 in blue, p+ buried region 33 in tan, and p-type substrate in gray. *See* Pet. 80–81. Referring to annotated Figure 16, Petitioner asserts that "Nishizawa depicts a source and drain (red, below) at the surface regions (blue), where buried region 33 (tan) provides an 'impurity concentration gradient . . . [that is] progressively decreasing toward the p type substrate' (gray)." Pet. 80 (quoting Ex. 1046, 19:4–5) (alterations by Petitioner). Petitioner further directs attention to Nishizawa's disclosure that

> the impurity concentration of that portion of the p+ type buried region 33a located adjacent the channel region and the n+ type regio 13 is set at about 1x1017 cm-3, with progressively lowered concentration as the portions of the buried region 33a go progressively toward the p type substrate 11, in such manner that the impurity concentration of lowermost portion of the

> buried region is less than at least one third of that of the highest impurity concentration.

Pet. 81 (quoting Ex. 1046, 18:50–59; citing Ex. 1046, 20:23–27). Against that backdrop, Petitioner argues, "Nishizawa teaches 'a drift electric field' that is created when there is a 'difference in the degree of impurity concentration,' which is used to drift minority carriers to the substrate." *Id.* (quoting Ex. 1046, 18:9–18). Petitioner further directs us to disclosures in Nishizawa indicating that "the impurity concentration has a downward gradient to the substrate." *Id.* (citing Ex. 1046, 18:36–67; 19:1–9).

i. Patent Owner's Arguments

With respect to Nishizawa, Patent Owner contends that Nishizawa does not cure the deficiencies of the patentability challenge based on Onoda alone. *See* PO Resp. 28. According to Patent Owner, "Nishizawa is directed to the same problem as Kawagoe, carriers created by alpha rays moving *up* from the *substrate*." *Id.* (citing Ex. 2057 ¶¶ 44–45, 59–60; Ex. 2058, 43:8–20). Patent Owner asserts that "Nishizawa expressly says that it was *not* addressing carriers at the surface of the device, because alpha rays do not create carriers there in large enough quantities to be relevant," and "Nishizawa says carriers at the surface of the device can be 'disregarded' for its purposes." *Id.* at 29 (citing Ex. 1046, 19:21–34, 20:19–22). Patent Owner argues that "[s]ince Nishizawa is silent on carriers in the surface layer, it does not teach the claim limitation." *Id.*

Patent Owner also contends that "Petitioner cannot simply rely on a gradient in Nishizawa for the same reason it cannot rely on the mere gradient in Onoda." PO Resp. 29. According to Patent Owner,

> [a]s with all the grounds, the Petition does not mention the net force on carriers in Nishizawa or analyze numerous relevant

> factors that act on carriers in addition to the gradient, (e.g. temperature, silicon imperfections, resistance, and slope). As with Onoda, there are electric field-creating PN junctions in Nishizawa that are not discussed in the Petition. Without analyzing these other forces, Petitioner has no basis to conclude that a mere gradient alone in Nishizawa would aid carrier movement.

Id. at 29–30 (citing Ex. 2058, 34:15–36:19, 39:8–12; Ex. 2057 ¶¶ 59–60) (emphasis omitted).

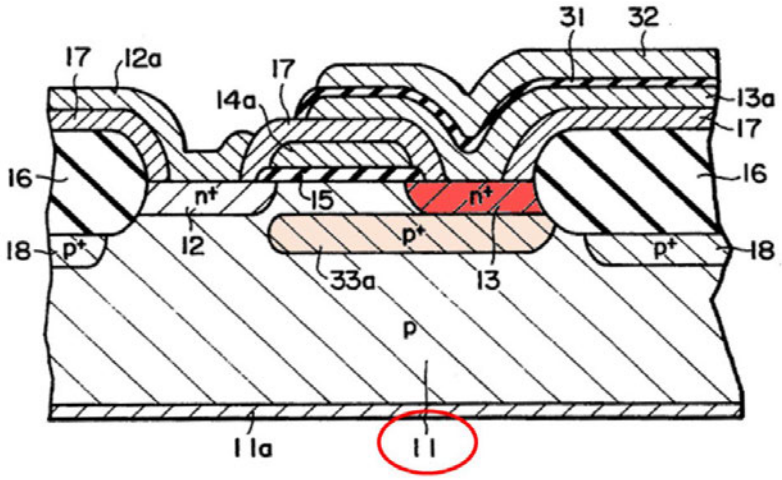
ii. Petitioner's Reply

Petitioner argues that Patent Owner "misrepresents Petitioner's usage of Nishizawa." Pet. Reply 19. First, Petitioner contends that Patent Owner "misrepresents the Petition as relying on Nishizawa to teach the 'surface,' and aiding carrier movement therefrom to the 'substrate,'" as "Petitioner did not rely on Nishizawa's device structure." *Id.* (citing Pet. 84). According to Petitioner, this challenge "relies on Onoda's device structure supplemented with Nishizawa's recognition that a layer with a downward dopant concentration *creates a field that drifts electrons downward*." *Id.* (citing Pet. 80) (emphasis added).

Second, Petitioner contends that Patent Owner "incorrectly argues that Nishizawa prevents the flow of electrons upwards and does not teach aiding them downward, and that electrons—generated by alpha-rays—at the surface can be ignored." Pet. Reply 19 (citing Pet. 28–29, IPR2023-01243, Paper 82 at 44). According to Petitioner, Patent Owner's "arguments contradict Nishizawa's teachings of a graded dopant concentration to drift electrons downward" and Patent Owner's "arguments that Nishizawa does not create ***any*** electrons at its surface are wrong." *Id.* at 19–20 (citing Ex. 1046, 18:4–6, 18:18–22; Ex. 1054 ¶ 10). Petitioner takes the position

that "Nishizawa teaches that an alpha-ray 'will not make many' electrons near the surface, which means that some are created." *Id.* at 20 (citing Ex. 1046, 17:14–16). FIG. 36 depicts electrons being generated across the alpha-ray's path in the initial 1 μm." *Id.* (citing Ex. 1046, Fig. 36, 19:67–20:5, 2:45–49 (Petitioner asserting that the reference "stat[es] that the n-type region goes 0.5 μm deep), 19:34–42, 19:56–67; Ex. 1055, 186:12–21 (Petitioner asserting that "Dr. Glew stat[es] that the claimed 'surface' is not size limited")).

Figure 35 of Onoda, annotated by Petitioner, is reproduced below.



Referring to annotated Figure 35, Petitioner contends that "Nishizawa teaches that a p+ type buried region 33a (tan)—with a substantially uniform dopant concentration—will prevent electrons generated in the p-type substrate 11 (red circle) from entering the p+ type buried region 33a." Pet. Reply 19–20 (citing Ex. 1046, 18:4–6, 18:18–22). According to Petitioner, "[a] uniform concentration, however, does not solve the problem of electrons generated via alpha-rays in the p+ type buried region 33a from reaching the n+ type region 13 (red)." *Id.* (citing Ex. 1046, 18:35–43). Petitioner further argues that "[t]o solve this problem, Nishizawa teaches 'it is only necessary to form an impurity concentration gradient in the p+ type

buried region 33a in the direction toward the p type substrate 11.'" *Id.* at 20 (citing Ex. 1046, 18:46–50; Ex. 1055, 104:5–14 (stating that this layer is creating a force to push electrons downward), 100:2–18 (same); Ex. 1054 ¶ 9). Petitioner further asserts that Figure 36 "depicts electrons being generated across the alpha-ray's path in the initial 1 μm." *Id.* (citing Ex. 1046, 19:34–42, 19:56–20:5, 2:45–49, Fig. 36; Ex. 1055, 186:12–21); *see id.* at 21 (reproducing Ex. 1046, Fig. 36).

iii. Analysis of Arguments

We have considered the cited evidence, including expert testimony, and the parties' arguments pertaining to the limitations of claims 1 and 21 that are in dispute. For the same reasons set forth above in Section III.E.2, Patent Owner's arguments are unavailing. That is, no particular magnitude or specific numerical value of slope must be shown in order to satisfy the claim limitations. Petitioner sufficiently shows that the combination of Onoda and Nishizawa teaches the relative slope encompassed by the scope of independent claims 1 and 21. Our reasoning above, presented in the context of the patentability challenge based on Kawagoe, applies with equal force here.

We find that "Onoda discloses multiple active regions whose dopant concentrations have a downward gradient, which a POSITA would have recognized as providing an electric drift field in the active region to aid the movement of minority carriers from the first surface to the second surface of the substrate (substrate 100)." Pet. 79–80 (citing Ex. 1003 ¶¶ 143–146, 452–453). We further find that "Nishizawa makes explicit that the downward gradient aids in the movement of carriers to the substrate." Pet. 80 (citing Ex. 1046, 18:47–50, 19:1–19, 18:10–18). Petitioner shows

persuasively how and why the combined teachings of Onoda and Nishizawa would have led to the claimed invention. Pet. 76–81; Pet. Reply 19–21.

Patent Owner, by contrast, focuses on perceived similarities between the disclosures of Nishizawa and Kawagoe (similarities which are unpersuasive to undercut Petitioner's showing of obviousness, for reasons set forth above in the context of the patentability challenge based on Kawagoe) and, where that fails, highlights individual shortcomings in each applied reference (Onoda and Nishizawa) without accounting adequately, if at all, for what the combined disclosures of those applied references would have fairly suggested to a person of ordinary skill in the art. *See* PO Resp. 28–30; PO Sur-reply 24. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

d. Conclusion with Respect to Claims 1 and 21

Based on the complete record developed during trial, we determine that Petitioner persuasively demonstrates that the combination of Onoda and Nishizawa teaches or suggests every limitation of claims 1 and 21. In addition, as discussed above in Section III.D., we give little weight to Patent Owner's evidence of objective indicia of nonobviousness, but even if it was given more weight, it would not overcome Petitioner's strong case of obviousness. Accordingly, we determine that Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 1 and 21 would have been obvious over Onoda and Nishizawa.

3. Analysis—Dependent Claims 3–9, 13, 15–17, 20, and 23–28

Petitioner identifies where the combination of Onoda and Nishizawa teaches or suggests every limitation of dependent claims 3–9, 13, 15–17, 20, and 23–28. *See* Pet. 63–76, 82. We have reviewed Petitioner's arguments and find that it is fully supported by the cited evidence. *See id.* Patent Owner does not address Petitioner's arguments with respect to these dependent claims, apart from the arguments addressing independent claims 1 and 21. *See* PO Resp. 28–30.

Based on the complete record developed during trial, we determine that Petitioner persuasively demonstrates that the combination of Onoda and Nishizawa teaches or suggests every limitation of dependent claims 3–9, 13, 15–17, 20, and 23–28. Accordingly, we determine that Petitioner demonstrates by a preponderance of the evidence that the subject matter of dependent claims 3–9, 13, 15–17, 20, and 23–28 would have been obvious over Onoda and Nishizawa.

4. Conclusion

For the reasons set forth above, Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 1, 3–9, 13, 15–17, 20, 21, and 23–28 would have been obvious over Onoda and Nishizawa.

IV. CONSTITUTIONALITY OF AIA

Patent Owner argues that "[t]he Board should dismiss this IPR, because the AIA violates the Supreme Court's non-delegation doctrine and the Constitution." PO Resp. 59. Patent Owner argues the Director improperly has authority to direct whether Patent Owner may receive legal process in the federal courts. *See id.* at 59–60 ("[T]he Director decides

whether [Patent Owner] 'should receive *certain legal processes* (those accompanying Article III proceedings)' such as the protections of a jury trial and the clear and convincing evidence standard for patent validity."). Patent Owner also takes issue with the Director's "unreviewable discretion" to institute proceedings. *See id.* at 60 ("Since Congress provided no intelligible principle for the Director to apply in deciding whether to institute IPR proceedings, the statute governing these proceedings is unconstitutional and the Petition must be dismissed."). The Supreme Court has already upheld the constitutionality of IPRs. *Oil States Energy Servs., LLC v. Greene's Energy Grp., LLC*, 584 U.S. 325, 344–45, (2018). The specific challenge raised by Patent Owner is also logically flawed. Patent Owner's argument that IPRs are unconstitutional because the Director decides whether Patent Owner "should receive *certain legal process*" (*see* PO Resp. 59–60) is unavailing because *inter partes* review proceedings do not foreclose Patent Owner from litigating its patents in an Article III court. Here, Patent Owner pushed for an Article III court (the District of Delaware) to evaluate the validity of its patents in parallel with *inter partes* review proceedings. *See* Prelim. Resp. 23; Ex. 2016 (complaint). That Article III court simply exercised its own discretion and stayed the case. *See id.*

As to the challenged "unreviewable discretion" of the Director, we note that the Federal Circuit recently denied petitions for writ of mandamus challenging such discretion. *See, e.g.*, *In re Motorola Sols., Inc.*, 159 F.4th 30, 36 (Fed. Cir. 2025) ("Congress committed institution decisions to the Director's discretion" and "protected that exercise of discretion from judicial review by making such determinations 'final and nonappealable.'" (citing 35 U.S.C. § 314(d); *SAS Inst., Inc. v. Iancu*, 584 U.S. 357, 366 (2018))); *see also United States v. Arthrex, Inc.*, 594 U.S. 1, 8–9 (2021)

("Congress has committed the decision to institute inter partes review to the Director's unreviewable discretion.").

V. PATENT OWNER'S MOTION TO EXCLUDE EVIDENCE

Patent Owner moves to exclude Petitioner's Exhibit 1059, titled "Understanding the *p-n* Junction," for being "irrelevant and lack[ing] proper authentication." Mot. Exclude 2. According to Patent Owner, "Exhibit 1059 is irrelevant under FRE 401 and 403, since there is ***zero*** evidence on the face of the document to determine whether it was published or publicly accessible before the critical date of the Challenged Patent." *Id.* Patent Owner further contends that "Petitioner has not offered any evidence sufficient to support a finding that the exhibit (and the pages cited in its Reply) is what Petitioner claims it is under FRE 901." *Id.* at 4.

We decline to strike Exhibit 1059 from the record, as we did not rely on it in any way in reaching our decision. *See supra* n.20. Accordingly, Patent Owner's Motion to Exclude Evidence is dismissed as moot.

VI. CONCLUSION

For the foregoing reasons, we determine that Petitioner demonstrates by a preponderance of the evidence that claims 1, 3–9, 13, 15–17, 20, 21, and 23–28 are unpatentable.[22] Our conclusions are summarized in the following table.

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1, 3–9, 13, 15–17, 20, 21, 23–28	103(a)	Kawagoe	1, 3–9, 13, 15–17, 20, 21, 23–28	
1, 3–9, 13, 15–17, 20, 21, 23–28	103(a)	Onoda	1, 3–9, 13, 15–17, 20, 21, 23–28	
1, 3–9, 13, 15–17, 20, 21, 23–28	103(a)	Onoda, Nishizawa	1, 3–9, 13, 15–17, 20, 21, 23–28	
Overall Outcome			1, 3–9, 13, 15–17, 20, 21, 23–28	

[22] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

VII. ORDER

For the foregoing reasons, it is:

ORDERED that Petitioner demonstrates by a preponderance of the evidence that claims 1, 3–9, 13, 15–17, 20 ,21, and 23–28 of the '014 patent are unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is dismissed as moot;

FURTHER ORDERED that, in view of the motions to seal, this Decision is filed "Board and Parties Only";

FURTHER ORDERED that, after conferring, the parties shall, *within one week of this Decision*, jointly submit to the Board via email to Trials@uspto.gov, a version of this Decision to be filed in the public record, with any redactions proposed by either party; and

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

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