

PUBLIC VERSION

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC,
Petitioner,

v.

GREENTHREAD, LLC,
Patent Owner.

IPR2024-00263
Patent 11,316,014 B2

Before KRISTEN L. DROESCH, GRACE KARAFFA OBERMANN, and
STEPHEN E. BELISLE, *Administrative Patent Judges*.

DROESCH, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

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 1–9 and 13–28 of U.S. Patent No. 11,316,014 B2 (Ex. 1001, “’014 patent”) are unpatentable.

A. Background & Procedural History

Semiconductor Components Industries, LLC d/b/a onsemi (“Petitioner” or “onsemi”) filed a petition requesting *inter partes* review of claims 1–9 and 13–28 of the ’014 patent. Paper 1 (“Petition” or “Pet.”). Greenthread, LLC (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 13 (“Prelim. Resp.”). With the Board’s authorization, Petitioner subsequently filed a Preliminary Reply (Paper 15) and Patent Owner filed a Preliminary Sur-reply (Paper 18) to address claim construction and privity disputes.

Upon review of the parties’ arguments and supporting evidence, we instituted review with respect to all grounds and claims set forth in the Petition. Paper 21 (“Inst. Dec.” or “Institution Decision”).

Patent Owner filed a Response to the Petition (Paper 31, “PO Resp.”), to which Petitioner filed a Reply (Paper 38, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 43, “PO Sur-reply”).

In support of the Petition, Petitioner relies upon a declaration of Travis Blalock Ph.D. (Ex. 1003), and Patent Owner relies upon declarations of Alexander D. Glew, Ph.D. (Ex. 2064) and Mohan Rao (Ex. 2078) in

support of the Patent Owner Response. The parties filed transcripts of depositions of Dr. Blalock (Ex. 2058) and Dr. Glew (Ex. 1056).¹

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 49.

An oral hearing was held on May 6, 2025, and a transcript of the hearing is included in the record (Paper 62, “Tr.”).

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 post-hearing discovery and briefing from the parties to address the privity dispute. Paper 61 (“Discovery Order” or “Disc. Order”). Petitioner produced a declaration of Matthew Murphy (Ex. 2914, “Murphy Declaration”). Mr. Murphy was deposed and the transcript of Mr. Murphy’s deposition (Ex. 2915)² is included in the record.

Patent Owner filed a Post-Hearing Brief Concerning Board-Ordered Discovery (Paper 67, “PO Privity Br.”), Petitioner filed a Petitioner’s Responsive Post-Hearing Brief Concerning Board-Ordered Discovery (Paper 70, “Pet. Resp. Privity Br.”), and Patent Owner filed a Patent Owner’s Reply Post-Hearing Brief Concerning Board-Ordered Discovery (Paper 71, “PO Reply Privity Br.”).

A telephonic hearing on post-hearing discovery and the privity dispute was held on September 18, 2025, and a transcript (Ex. 1064, “Privity Tr.”) is included in the record.

¹ Dr. Blalock and Dr. Glew were deposed during the trial proceedings for IPR2023-01242, -01243, and -01244.

² The record includes two of Exhibit 2915, a public version and a sealed version.

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); and

Cirrus Logic v. Greenthread, LLC, IPR2024-00019, filed October 27, 2023.

Pet. 1–2; Paper 4, 2–3 (Patent Owner's mandatory notices).

Petitioner also indicates that the '014 patent was the subject of numerous additional proceedings. Pet. 3; Paper 4, 5–6.

C. Real Parties in-Interest

Petitioner identifies itself and ON Semiconductor Corporation as the real parties-in-interest. Pet. 1. Patent Owner identifies itself as the real party-in-interest. Paper 4, 2. In the transcript of the telephonic hearing concerning post-hearing discovery and the privity dispute, the parties confirmed that, for Petitioner, the undisputed real parties in interest are Semiconductor Components Industries, LLC, and ON Semiconductor Corporation. *See Privity Tr.* 7:7–17.

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.

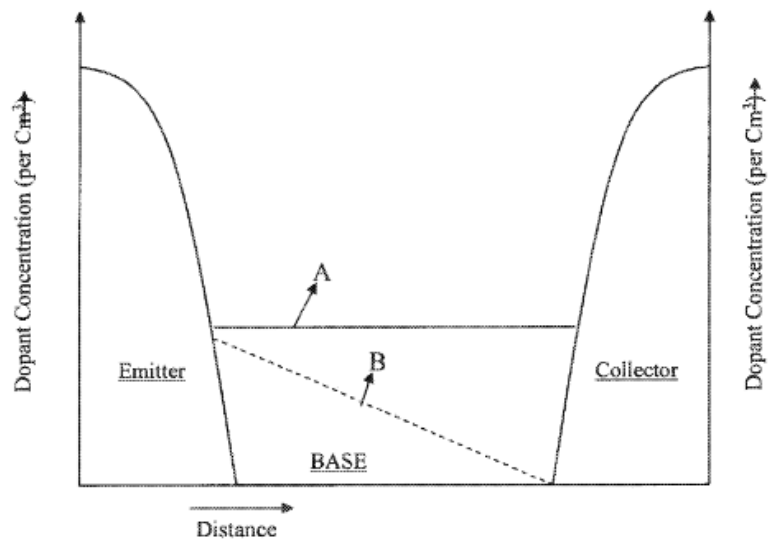


Figure 1 is labeled “Prior Art” and “illustrates the relative doping profiles of emitter, base and collector for the two most popular bipolar junction transistors: namely, uniform base (‘A’) and graded base (‘B’).” Ex. 1001, 2:40–43, Fig. 1.

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

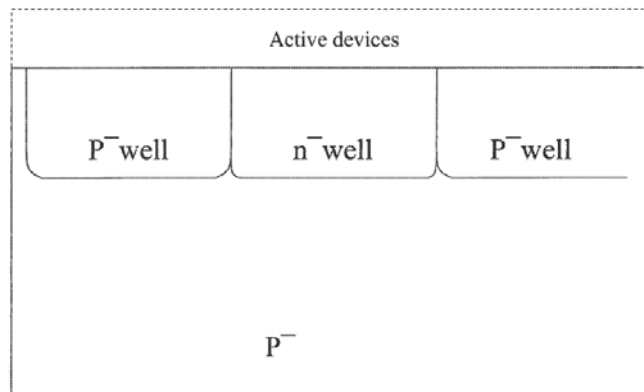


Figure 3A is labeled “Prior art” and shows a cross section of “a typical prior art integrated circuit (IC) with two wells (one n^- well in which p-channel transistors are subsequently fabricated and one p^- well in which n-channel transistors are subsequently fabricated).” Ex. 1001, 2:46–51, Fig. 3A.

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

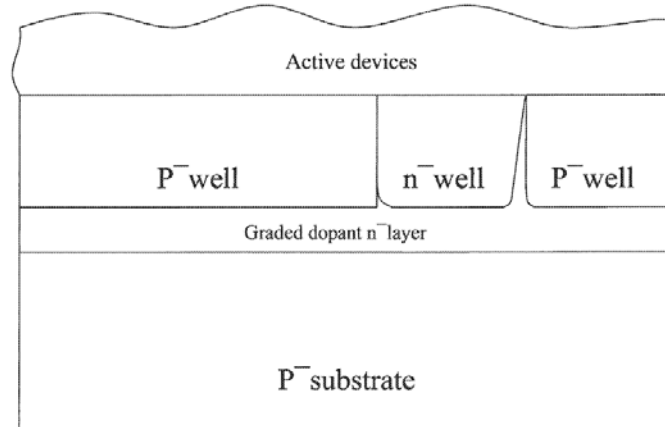


Figure 5A illustrates a cross section of a CMOS silicon substrate with two wells and an underlying layer using embodiments of the invention. *See* Ex. 1001, 2:58–61. According to the '014 patent, “[s]purious minority carriers can be generated by clock switching in digital VLSI logic and memory ICs.” *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.

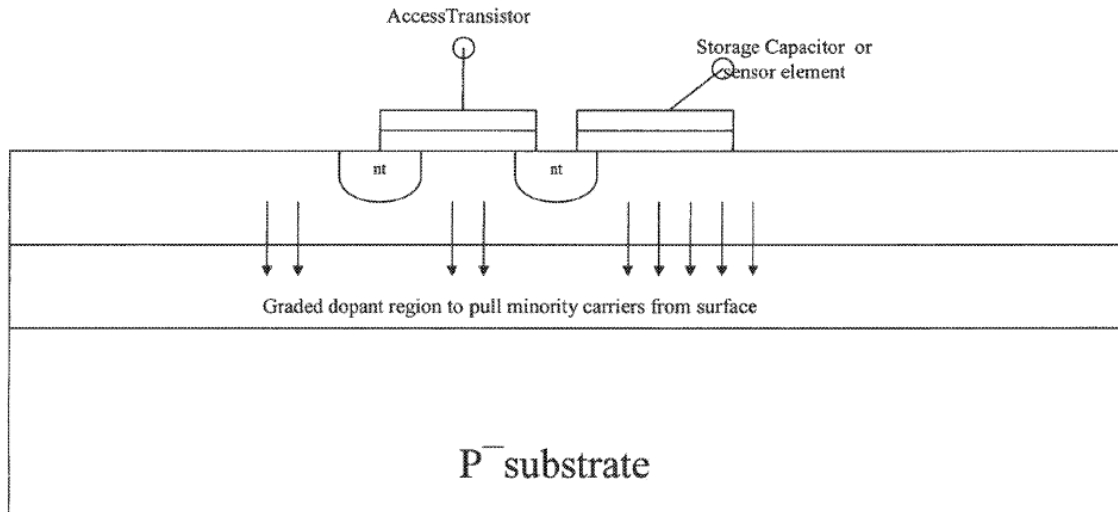


Figure 5B depicts n-type wells in a P-type substrate and includes arrows facing downwards towards the P-type substrate and a label: “Graded dopant region to pull minority carriers from the surface.” Ex. 1001, Fig. 5B; Ex. 1060 ¶ 81; Ex. 2064 ¶¶ 36–37.

E. Illustrative Claim

Claims 1 and 21 are independent, with claims 2–9 and 13–20 dependent from claim 1, and claims 22–28 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 1–9 and 13–28 would have been unpatentable based on following grounds (Pet. 6):

Claims Challenged	35 U.S.C. § ³	Reference(s)/Basis
1–9, 13, 14, 16–28	103(a)	Kawagoe ⁴
1, 2, 4–9, 13–23, 25–28	103(a)	Wieczorek ⁵ , Wolf ⁶
1–9, 13, 14, 16–28	103(a)	Kawagoe, Gupta ⁷
1, 2, 4–9, 13–23, 25–28	103(a)	Wieczorek, Wolf, Gupta
19	103(a)	Kawagoe, Silverbrook ⁸
19	103(a)	Wieczorek, Wolf, Silverbrook

³ 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).

⁴ US 6,043,114, issued Mar. 28, 2000 (Ex. 1007).

⁵ US 2003/0183856 A1, published Oct. 2, 2003 (Ex. 1006).

⁶ Stanley Wolf & Richard N. Tauber, *Silicon Processing for the VLSI Era*, vols. 1–4 (Lattice Press 2000) (Ex. 1008).

⁷ US 6,163,877, issued Dec. 19, 2000 (Ex. 1014).

⁸ US 6,614,560 B1, issued Sept. 2, 2003 (Ex. 1046).

II. PRIVACY – 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 privacy with [REDACTED] [REDACTED]⁹ Intel Corp. (“Intel”), and [REDACTED] [REDACTED] (collectively “Licensees”), who Patent Owner asserts are time-

⁹ During the pre-institution phase of this proceeding, Patent Owner asserted a privacy relationship between Petitioner and [REDACTED] but identified no evidence sufficient to support a finding that Petitioner provided a product that was accused of infringement in the [REDACTED] litigation. *See* Prelim. Resp. 2–3 (identifying the [REDACTED] litigation), 5–8, 10, 16–18, 27 & n.7, 33 (declining to identify any product provided by Petitioner that was accused in the [REDACTED] litigation). During the trial phase of this proceeding, by contrast, Patent Owner expressly limited its privacy assertions to Petitioner’s alleged relationships with Intel and “both [REDACTED] and [REDACTED] two other time-barred parties,” effectively waiving any argument that Petitioner is time barred based on a privacy relationship with [REDACTED] PO Privacy Br. 2 n.3. In view of that waiver, we do not address any alleged privacy relationship with [REDACTED]. Alternatively, because Patent Owner produced no evidence at any time during this proceeding sufficient to establish that Petitioner had an opportunity to control the [REDACTED] litigation or is acting as a proxy for [REDACTED] in this proceeding, we find that Petitioner was not in privacy with [REDACTED] during the [REDACTED] litigation and no time bar arises on that basis under Section 315(b). *See id.*

barred under 35 U.S.C. § 315(b) and licensed under the '014 patent. *See* PO Resp. 42–59. 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. 18–38.

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. 33–43. We incorporate that analysis here, and reconsider Patent Owner’s contentions to the extent it is warranted by subsequent, post-hearing 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. 46–48); (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 48–53); (3) evidence of record shows that the petition is time-barred (*see id.*

at 53–59); and (4) a finding in Petitioner’s favor would violate Patent Owner’s constitutional right to due process (*see id.* at 59–62). 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. 60–61. The Board has 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 1, 2025, we held a teleconference with the parties to discuss the impact of the Director Review Order on various Greenthread proceedings, including this one. *See* Ex. 1063 (transcript of conference). During that teleconference, Patent Owner indicated that, notwithstanding the Director Review Order, it did not wish to pursue additional discovery in such proceedings, but instead, citing *Worlds Inc.*, argued it is entitled to judgment, as a matter of law, that institution should not have been granted based on the existing record. *See id.* at 11:20–12:19.

During a consolidated oral hearing held on May 6, 2025, Patent Owner’s counsel reiterated Patent Owner’s position to not pursue additional discovery in this proceeding, notwithstanding the Director’s Review Order in the first wave cases. Tr. 69:10–20. Accordingly, in this proceeding (as well as in IPR2024-00264, IPR2024-00265, and IPR2024-00266), we *sua sponte* issued a Post-Hearing Discovery Order “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;¹⁰ and

[ii. i]ndemnification agreements between Petitioner and Intel for the Intel Accused Products. *See* [IPR2023-001242, Paper 94, 3].

¹⁰ 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.

- (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 (internal quotations omitted).

In response to the Board’s Discovery Order, Petitioner produced a Declaration of Mathew Murphy, and Mr. Murphy was cross-examined. *See* Exs. 2914, 2915.¹¹ 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. A telephonic hearing also was held on September 18, 2025. *See* Privity Tr.

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

¹¹ The record includes two of Exhibit 2915, a public version and a sealed version. We cite to the *sealed* version of this exhibit.

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”)¹² 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

¹² Available at www.uspto.gov/patents/ptab/trial-practice-guide.

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.¹³

- (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 (emphasis added).
- (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 (emphasis added).
- (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 900 (emphasis added).
- (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.* (emphasis added).
- (6) “[A] *special statutory scheme*,” such as bankruptcy or probate, “may ‘expressly foreclose successive litigation by nonlitigants . . . if the scheme is otherwise consistent with due process.’” *Id.* (emphasis added)

¹³ 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.

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. Zenzi 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 (internal quotations 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. 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 RPIs.” PO Privity Br. 2 (internal footnote omitted). 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 P[atent Owner]’s portion of the Joint Paper Concerning Additional Discovery” filed in IPR2023-01242. *Id.* at 2 n.3 (citing IPR2023-01242, Paper 108 at 2–5).

Based on those allegations, Patent Owner takes issue with Petitioner’s Murphy Declaration (Ex. 2914) as “merely repeat[ing] its previously-offered attorney argument without providing any additional detail, documentation, or substantiation to those arguments.” PO Privity Br. 4; *see id.* at 5–6.

Patent Owner contends that Petitioner’s Declarant, Mr. Murphy, “did not contact anybody within the company or at Intel to discuss whether any Intel parts (accused or otherwise) included Petitioner’s components.” *Id.* at 6; *see id.* at 7–11.

Patent Owner contends, *instead*, that “[a]ll Mr. Murphy ‘confirmed’ was that Petitioner does not sell the Intel Accused Products (IAPs) *to* Intel, something that PO has never alleged.” PO Privity Br. 6. Patent Owner takes the position that “Petitioner has not established whether or not it was the ‘supplier of any . . . **component** of a product[] accused in the Intel litigation,’ as required by the Board.” *Id.* at 8 (citing Disc. Order 6) (alterations by Patent Owner). Patent Owner further contends that Petitioner’s Declarant, Mr. Murphy, did not consult with the parties or people who would possess relevant information and that Petitioner failed to present any documentary evidence supporting Mr. Murphy’s statements. *Id.* at 9–15.

D. Petitioner’s Arguments

Petitioner contends that “Intel and onsemi are not in privity,” and Patent Owner’s “speculative and disproven arguments are not sufficient under *Worlds* or any other known jurisprudence to indicate that onsemi is time-barred.” Pet. Resp. Privity Br. 1, 11. According to Petitioner, “[t]he evidence is undisputed that ‘onsemi does not currently and has never sold any of the Intel Accused Products’ and ‘onsemi does not currently and has never sold any component of the Intel Accused Products.’” *Id.* at 1 (footnote

omitted) (citing Ex. 2914 ¶ 7). Petitioner contends that “discovery has confirmed that Intel *never* sought indemnity from onsemi for the Intel [l]itigation . . . , which makes sense because no onsemi products were at issue in the case.” *Id.* at 11 (citing Ex. 2914 ¶¶ 7, 8); *see id.* at 6.

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 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 and post-hearing discovery 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 Patent Owner “does not (and cannot) dispute that onsemi was not aware of the Intel litigation until Friday, April 21, 2023, when Greenthread sued onsemi.” Pet. Resp. Privity Br. 1 (citing Ex. 2914 ¶¶ 9–10). Petitioner further contends that “[b]ecause the Intel litigation was dismissed the very next Monday, April 24, 2023, as a matter of timing, it would have been impossible for onsemi to be involved in the Intel litigation, much less exercise any control over it.” *Id.* Mr. Murphy credibly testifies that onsemi was not “in a position to control,” nor did onsemi “actually control any aspect of Intel’s defense of the Intel [l]itigation.” Ex. 2914 ¶ 10; *see id.* ¶ 9.

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 IPRs¹⁴, we next consider Petitioner’s and Intel’s relationship, as it relates to the Intel litigation. We

¹⁴ Patent Owner does not assert that Intel is an RPI to the present proceeding.

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 1319, 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 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 Privy Br. 2; Tr. 69:10–20), the Director did not indicate that Patent Owner had met its 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).

Notwithstanding Patent Owner’s arguments, addressed below, we find persuasive Petitioner’s Declarant’s testimony that Petitioner lacks any connection to the Intel Accused Products:

Because onsemi has never sold any of the Intel Accused Products or any component of any of the Intel Accused Products to Intel (*or to anyone else*), I can confirm that onsemi has never signed and does not possess any customer

agreements, sales agreements, indemnification agreements, or any other documents concerning the sale of the Intel Accused Products.

Ex. 2914 ¶ 7 (emphasis added). Mr. Murphy has been “the Vice President of Sales, Americas, at Semiconductor Components Industries, LLC (‘onsemi’)” for “approximately the last four years,” and has “been employed by onsemi and its predecessor company in various positions for more than twenty-five years.” *Id.* ¶ 3. Because of his “current role and . . . long history in sales-related roles at onsemi,” Mr. Murphy testifies that he is “familiar with . . . whether any particular onsemi product has been sold to Intel Corporation (‘Intel’) in particular.” *Id.* ¶ 4. We are persuaded that his experience supports that he had sufficient knowledge to make the attestation set forth above.

Mr. Murphy’s deposition testimony also supports his Declaration testimony. Ex. 2915, 26:9–13 (“None of the parts [onsemi] sell[s] would be part of a[n] Intel CPU.”), 33:20–34:8 (“Q. As you sit here today testifying under penalty of perjury, can you tell me definitively whether any of the products listed on Pages 4 through 8 of Exhibit 2048, include an onsemi part or product? A. I can confirm they do not.”), 35:14–19 (“I can confirm that onsemi does not currently and has never sold any of the Intel accused products. And I can confirm that onsemi does not currently and has never sold any component of the Intel accused products.”), 36:15–17 (“I do not sell any of these accused products or any component of those products to Intel.”), 83:6–12 (“Q. . . . Do you know whether the Intel Atom C2308 in fact included onsemi or Semiconductor Components Industries, LLC parts or elements? . . . [A.] I know that it does not include components of onsemi or Semiconductor Components Industries, LLC.”).

In response to Patent Owner’s allegation that “‘Mr. Murphy clearly admitted that he does not know’ whether the Intel Accused Products include an onsemi part,” Petitioner clarified that “Mr. Murphy misunderstood one line of questions and answered in a way that suggested he did not know whether the Intel Accused Products included onsemi components.” Pet. Resp. Privy Br. 12 (citing Ex. 2915, 62:3–17). Petitioner persuasively argues that “Mr. Murphy corrected this misunderstanding both on redirect and in the errata to his deposition.” *Id.* (citing Ex. 2915, 62:3–17, 83:6–84:11, 104:1–22). Petitioner contends, and we agree, that “[t]he full record thus shows that Mr. Murphy knows that the Intel Accused Products *do not* include onsemi components.” *Id.* (citing Ex. 2915, 33:20–34:8). We are neither apprised of, nor can discern evidence of, inaccuracies, inconsistencies, or any other impropriety, particularly as Mr. Murphy testified under penalty of perjury.

We agree with Petitioner that “the best source of proof for this *negative* point—*i.e.*, that onsemi *does not supply* the Intel Accused Products or components thereof—is testimony from a person knowledgeable about onsemi’s business,” and agree that “Mr. Murphy’s declaration and deposition testimony resolves this question.” Pet. Resp. Privy Br. 13; *but see* PO Privy Br. 14–15.

The Board did not order a particular style or depth of investigation (*see* Disc. Order 9), 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 our Discovery Order required Petitioner’s Declarant to contact Intel to determine whether IAPs (Intel Accused Products) include components sold or manufactured by Petitioner’s distributors, manufacturing fabrication plants, or corporate affiliates as part

of their investigation. *See, e.g.*, PO Privity Br. 9–13. The Declaration produced by Petitioner is sufficient to comply with the Discovery Order.

We further agree with Petitioner’s contention that Patent Owner’s teardown analyses of the IAPs do not tend to show that the IAPs contain any components that are supplied by any third parties, much less Petitioner; otherwise, Patent Owner would have identified such components and suppliers of such components in its infringement contentions. *See* Pet. Resp. Privity Br. 7–8. Thus, the teardown analysis supports Petitioner’s view that the accused products in the Intel litigation are limited to the enumerated Intel products listed in Exhibit 2048. Our analysis, in that regard, satisfies the Director’s mandate that we resolve, on the full record, whether “Petitioner was a supplier of” products that were “accused of practicing the challenged claims” in the Intel litigation. Dir. Rev. Order 3. The resounding answer is no.

Indirect Sales and Third-Party Resellers

Patent Owner alleges that “any investigation into Petitioner’s supplier relationship with Intel was cabined solely to whether or not there are direct sales or indemnity agreements for the complete IAPs themselves.” PO Reply Privity Br. 6. Patent Owner contends that “Petitioner did not truly investigate whether its products were incorporated into the IAPs” and “never investigated whether any of Petitioner’s affiliates, subsidiaries, or third-party resellers provide parts that Intel then incorporates into its products.” *Id.* at 12 (emphasis omitted) (citing PO Reply Privity Br. § II.B); *see* PO Privity Br. 12. 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 9. 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. Nevertheless, Mr. Murphy repeatedly testified that “onsemi does not in fact sell to Intel (*or any other party*) any components of the Intel Accused Products.” Pet. Resp. Privity Br. 7 (emphasis added) (citing Ex. 2914 ¶ 7; Ex. 2915, 26:9–13, 33:20–34:8, 35:14–19, 36:15–17, 83:6–12).

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, even assuming, *arguendo*, that Patent Owner is correct that “[i]t is undisputed that Intel is one of Petitioner’s customers” and “Intel confirms that Petitioner is one of its suppliers,” this argument is unavailing. See PO Privity Br. 2–3 (citing Ex. 2009, 2 (listing Intel as a “[t]op OEM customer”); Ex. 2915¹⁵, 63:15–17, 38:1–3; Ex. 2004, 10–13). A “manufacturer-customer relationship alone does not establish privity” at least because any such relationship does not concern supplying *IAPs or components thereof*. Pet. Resp. Privity Br. 5 (quoting *Samsung Electronics Co. Ltd. v. Netlist Inc.*, IPR2022-00615, Paper 64 at 23 (PTAB June 30, 2023) (citation omitted)); *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)).

¹⁵ Patent Owner incorrectly cites an exhibit not in the record.

According to Patent Owner, “[p]er its ‘Standard Terms and Conditions of Sale’ (T&Cs), Petitioner indemnifies its customers.” PO Privy Br. 3 (citing Ex. 2010). Patent Owner asserts that “[t]hese T&Cs apply to all onsemi sales and every customer, including Intel.” *Id.* (citing Ex. 2915¹⁶, 43:19–44:6, 45:14–46:5 (“Q. Are you aware as to whether or not there is a different agreement in place for sales made by onsemi to Intel? A. No.”)). Patent Owner further contends that “Mr. Murphy confirmed that the indemnity provisions of Petitioner’s Standard T&Cs require Petitioner to ‘indemnify a buyer based upon a claim of patent infringement of a product purchased from onsemi.’” *Id.* (citing Ex. 2915¹⁷, 74:15–22). Those arguments are rendered moot by Mr. Murphy’s unequivocal testimony on point. We agree with Petitioner that the evidence supports a finding that “discovery has confirmed that Intel *never* sought indemnity from onsemi for the Intel [l]itigation . . . , which makes sense because no onsemi products were at issue in the” Intel litigation. Pet. Resp. Privy Br. 11 (citing Ex. 2914 ¶¶ 7–8).

Adjacency to Intel Accused Products (IAPs)

To the extent that Patent Owner argues that Petitioner’s product was accused because it is capable of being in the same system as an IAP (*see* Ex. 2006, Fig. 2; Privy Tr. 21:22–28:2), we find these arguments unavailing. That is not what Patent Owner specifically identified in its infringement contentions as practicing the challenged claims. The system(s) identified by Patent Owner are accused solely on the basis that the

¹⁶ Patent Owner incorrectly cites an exhibit not in the record.

¹⁷ Patent Owner incorrectly cites an exhibit not in the record.

infringement derives from the IAPs specifically identified in the list of infringement contentions. *See* Ex. 2048, 4–9.

Providing Custom Products to Customers

To the extent that Patent Owner suggests that, because “Petitioner [] makes custom products for its OEM customers,” such collaboration implies privity, presumably with Intel, we disagree. PO Privity Br. 3 (citing Ex. 2053; Ex. 2915¹⁸, 29:2–13). Instead, we agree with Petitioner that “generally collaborating and making custom products” is not dispositive and, instead, “[w]hat matters for privity is that onsemi did **not** make the Intel Accused Products or components thereof.” Pet. Resp. Privity Br. 11 (citing Ex. 2914 ¶ 7); *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 v. Netlist*, IPR2022-00615, Paper 64 at 22–26 (same).

Alleged Sub-license to RPX

Patent Owner contends that “Intel confirms that Petitioner is one of its suppliers” 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 PO.” PO Privity Br. 2–3 (citing Ex. 2004, 10–13; Ex. 2022, 3). Petitioner correctly points out that Patent Owner’s argument is unavailing because Patent Owner “has not produced the actual sublicense from RPX to Intel; an

¹⁸ Patent Owner incorrectly cites an exhibit not in the record.

agreement between RPX and Greenthread cannot create privity between onsemi and Intel; and this RPX agreement does nothing to show a connection between onsemi and the Intel litigation.” Pet. Resp. Privity Br. 10–11.

Summary

In view of the above, the evidence adduced during trial and post-hearing discovery 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 of some evidence to support its argument that Intel should be named as a privy). Moreover, even if we were to agree that Patent Owner met their burden of production of “some evidence,” the totality of evidence adduced during trial and post-hearing discovery 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.

As for Patent Owner’s argument 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” filed in IPR2023-01242, IPR2023-01243, and IPR2023-01244, we decline to address this argument. PO Privity Br. 2–3 n.3 (citing IPR2023-01242, Paper 108 at 2–5). The Director Review Order made clear that the Final Written Decisions in these related proceedings 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.

Moreover, [REDACTED] was served with an infringement complaint on January 23, 2023 (*see* Ex. 2019), and the Petition in the present proceeding was filed on December 11, 2023—[REDACTED] could not reasonably be, based on the evidence before us, considered a party giving rise to a time bar under § 315(b). [REDACTED] is not alleged to be an RPI or privy of Petitioner. *See* PO Resp. 44 (identifying Licensees as [REDACTED] Intel, and [REDACTED]). Rather, [REDACTED] is alleged to be an RPI of an alleged RPI—[REDACTED] (*see id.* at 42–43)—a degree of separation that is not contemplated by the clear language of the statute.

We turn next to Petitioner’s patentability challenges. In doing so, we note that the Supreme Court in *Thryv* emphasized that “Congress prioritized *patentability* over § 315(b)’s timeliness requirement,” and by providing for *inter partes* review, “sought to weed out bad patent claims efficiently.” *Thryv*, 590 U.S. at 55 (emphasis added). The Court also emphasized that the statutory scheme of *inter partes* review “consistently elevat[es] resolution of patentability above a petitioner’s compliance with § 315(b) . . . , thereby preserving the Board’s adjudication of the merits.” *Id.*; *see id.* (“[B]ecause a patent owner would need to appeal on § 315(b) untimeliness grounds only if she could not prevail on patentability, § 315(b) appeals would operate to save bad patent claims.”).

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. 6 (citing Ex. 1003 ¶ 48). Petitioner further contends that “[a]dditional education might compensate for less 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. 9 (citing Ex. 2064 ¶¶ 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. 6; PO Resp. 10.

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. 10–11. We address Patent Owner’s “aid movement of carriers” arguments below in our discussion of the patentability challenge based on *Kawagoe*, specifically the discussion of “graded dopant concentration to aid carrier movement” below in Section III.E.2.b.ii.

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 non-obviousness 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. 5, 39. Patent Owner further argues that because the licensees, [REDACTED] and [REDACTED] approached Patent Owner through RPX without threat of litigation against them, the RPX license agreement is especially probative of non-obviousness. *See id.* at 39–40 (citing Ex. 2078; *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)); PO Sur-reply 14–15. 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 id.* at 40–41 (citing Exs. 2060, 2068, 2072); PO Sur-reply 15 (citing Ex. 2078 ¶¶ 2–3, pp. 19, 45). 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. at 41.

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] and [REDACTED] licenses were made through RPX, which structures its arrangements to avoid litigation costs. *See* Pet. Reply 27–28 (citing Ex. 1057).

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] or [REDACTED] were ‘motivated by avoiding litigation costs.’” PO Sur-reply 15 (citing Pet. Reply 28).

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. 2078, 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. 40 (quoting Ex. 1001, 3:52–56)) is “part and parcel” with the RPX license (*id.*). 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 is especially probative because [REDACTED] and [REDACTED] were under no apparent threat of litigation. *See id.* at 39–40. Although Patent Owner argues that the RPX license was not motivated by a threat of litigation, (*see id.* at 39–40), 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. 1057, 1. RPX further markets itself

as working on behalf of its clients to prevent potential litigation and associated legal defense costs and settlements. *Id.* at 3.

In view of this evidence, Patent Owner’s argument that [REDACTED] and [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] and [REDACTED] made towards the lumpsum licensing fee, relative to the contribution of [REDACTED] and/or any other RPX member. Ex. 2078 ¶ 6. The record is not sufficiently developed to determine whether contribution amounts of [REDACTED] and [REDACTED] are significant compared to the potential cost of litigation. *See* Ex. 2078.

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. 41), 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 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 challenge based on *Kawagoe* (a single reference obviousness ground) and the patentability challenge based on *Wieczorek* and *Wolf* 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 1–9, 13, 14, and 16–28 would have been obvious in view of *Kawagoe*. *See* Pet. 7–40.

1. Overview of Kawagoe

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,”¹⁹ 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 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,

¹⁹ Petitioner submits Exhibit 1009 (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. 1009, Abstract, 430. Dr. Blalock characterizes “latchup” as “a ‘short-circuit’ failure condition in poorly designed circuits.” Ex. 1003 ¶ 79.

Figs. 16–25). Figure 1, reproduced below, depicts the device of Embodiment 1.

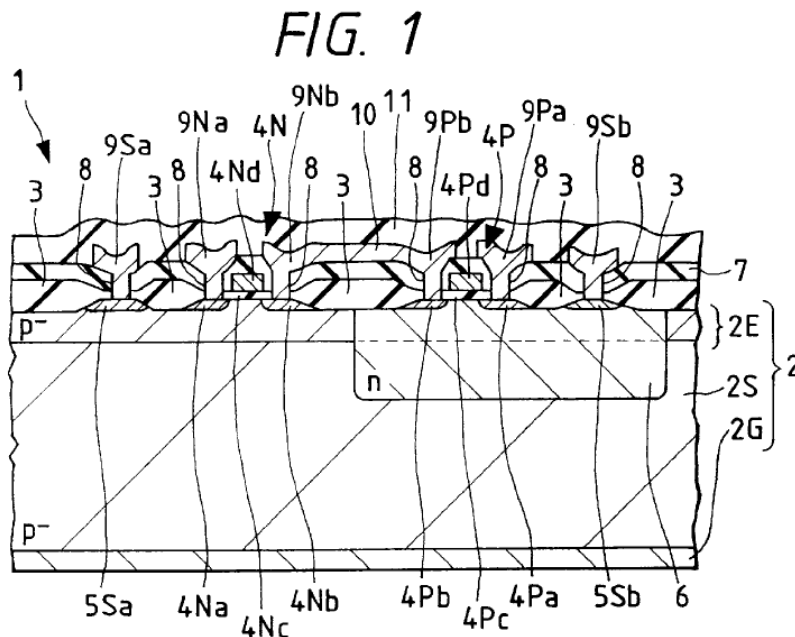


Figure 1 depicts “an essential portion of a semiconductor integrated circuit device” that includes semiconductor substrate body 2S, epitaxial layer 2E, and gettering layer 2G. Ex. 1007, 6:51–56, Fig. 1. Substrate body 2S and epitaxial layer 2E are doped with a p-type impurity in equal concentrations. *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 23, reproduced below, depicts a semiconductor device of Embodiment 4 in the process of manufacture. Ex. 1007, 17:11–13.

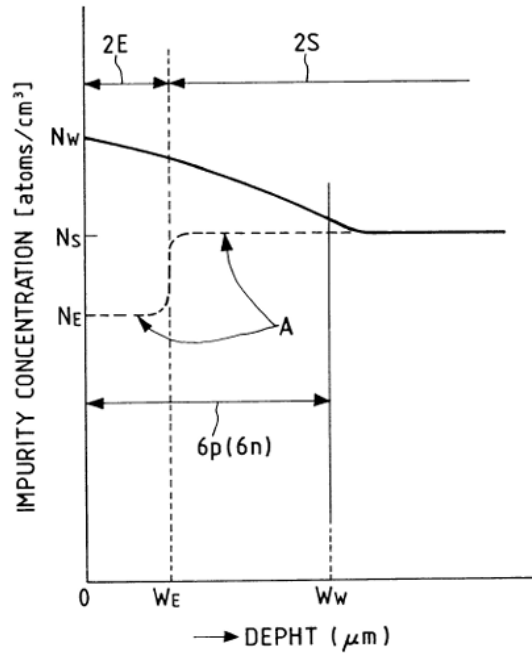


Figure 17 is a plot of impurity concentration as a function of depth in a semiconductor integrated circuit device, which shows “the p-well 6*p* and n-well 6*n* have their impurity concentrations gradually lowered in the depthwise direction from the principal surface (having an impurity concentration 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.

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.”²⁰ Ex. 1001, 4:49–51, 6:4–6. Petitioner contends that, to the extent the preamble is limiting, Kawagoe teaches the preamble and first limitation based on Kawagoe’s disclosure of a “semiconductor integrated circuit device,” such as the CMOS device of Figure 23 fabricated on a uniformly-doped epitaxial substrate. Pet. 7–8 (reproducing Ex. 1007, Fig. 23 (with Petitioner’s added annotations); citing Ex. 1007, code (54), 1:13–23, 14:46–67, 19:15–16, 20:1–33, 22:10–23:14, 24:28–31, Figs. 16, 17, 23, 26(A), 28; Ex. 1003 ¶¶ 66–68).

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 a “semiconductor substrate body 2S” and epitaxial layer 2E, both having a first doping type (p-type), with the substrate as a whole having “a surface.” See Pet. 9 (reproducing Ex. 1007, Fig. 23 (with Petitioner’s annotations added), citing Ex. 1007, 14:61–15:12, 6:50–7:3). Petitioner contends that Kawagoe discloses forming Figure 23’s twin-well CMOS device (Embodiment 4) on either Embodiment 1’s uniformly-doped epitaxial substrate or Embodiment 4’s optional latchup-resistant substrate. See *id.* at 11 (citing Ex. 1003 ¶ 74). According to Petitioner, a person of ordinary skill in the art would have sought to use the

²⁰ Petitioner uses bracketed language to show the differences between claims 1 and 21. Pet. 7 n.3. We use this convention as well.

uniformly-doped (“a first doping level”) epitaxial substrate of Embodiment 1 of Kawagoe, as opposed to Embodiment 4’s latchup-resistant substrate, to form the twin-well CMOS device of Figure 23 because this would optimize costs over latch-up resistance, and because a uniformly-doped epitaxial substrate “drastically reduce[s] the defect densities of the gate insulating films” of CMOS transistors. *See id.* at 11–13 (citing Ex. 1007, 8:40–52, 12:8–40, 14:58–60, 15:7–40, 19:49–63; Ex. 1003 ¶¶ 75, 78, 79).

Claims 1 and 21 also recite “a first active region disposed adjacent the surface [of the substrate] with a second 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 “semiconductor regions 4Na and 4Nb” that are used “for forming the *source-drain regions* of the nMOS [n-channel transistor] 4N.” Pet. 13–14 (citing Ex. 1007, 3:30–37, 8:46–67, 14:46–55, 15:26–40; Ex. 1003 ¶ 81; Ex. 1008B, 299–300). Petitioner asserts that source-drain regions 4Na/4Nb, in conjunction with the channel region between these regions, form part of the claimed first active region. *See id.* at 14 (reproducing Fig. 23 (with Petitioner’s added annotations); citing Ex. 1007, 8:46–65, 14:46–55, 15:26–40; Ex. 1008B, 299–300, 382, 387, Figs. 5-2, 6-8(c), 6-10; Ex. 1008C, 525, Fig. 8-1(e); Ex. 1003 ¶ 81). Petitioner further contends that regions 4Na and 4Nb have a second doping type (n-type) opposite in conductivity to the first doping type (p-type) of the substrate. *See id.* at 14 (citing Ex. 1007, 8:67–9:3, 14:46–55, 15:26–40; Ex. 1003 ¶ 81). Petitioner also contends that nMOS transistor 4N is formed in the claimed first active region and that Kawagoe teaches forming multiple nMOS transistors in this region to minimize chip area, “as good layout practice dictates.” *See id.* at 15 (citing Ex. 1003 ¶ 82; Ex. 1014, 1:52–54, 2:17–21).

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 semiconductor regions (source-drain regions) 4Pa and 4Pb are part of the claimed second active region, which also includes the channel region that is between them and below gate 4Pd. *See* Pet. 16 (citing Ex. 1007, 3:35–37, 8:46–57, 9:41–48, 14:46–55, 15:26–40; Ex. 1008B, 299–301; Figs. 5-1, 5-2, 6-4; Ex. 1003 ¶ 85). According to Petitioner, “[a]s shown in Figure 23, pMOS transistor 4P is formed in the surface of this second active region . . . , which is separate from and disposed adjacent to the first active region.” *Id.* at 16–17 (citing Ex. 1007, 14:46–55; Ex. 1003 ¶ 85); *see id.* at 17 (reproducing Ex. 1007, Fig. 23 (with Petitioner’s annotations added)). Petitioner contends that a person of ordinary skill in the art would have understood that Kawagoe teaches forming multiple pMOS transistors in this region. *See id.* at 17 (citing Ex. 1020, 31; Ex. 1003 ¶ 87).

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 teaches that the transistors in its active regions may form a CMOS circuit or be applied to a logic circuit such as a microcomputer. *See* Pet. 28 (citing Ex. 1007, 8:46–52, 14:46–55, 15:26–40, 20:1–33, 22:10–29, 22:51–23:2, 24:28–31; Ex. 1008A, 810–811; Ex. 1003 ¶ 108).

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, as

shown in Figure 17, the graded dopant concentration of Kawagoe is linear or nearly linear (quasilinear). Pet. 28–29 (reproducing Ex. 1007, Fig. 17 (with Petitioner’s annotations added); citing Ex. 1003 ¶ 109).

Patent Owner does not dispute Petitioner’s contentions that Kawagoe teaches the aforementioned undisputed limitations of claims 1 and 21. See PO Resp. 11–37. Based on the complete record developed during trial, we determine that Petitioner 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. 11–33): (1) “a first active region . . . with a second doping type opposite in conductivity to the first doping type,” and (2)

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.

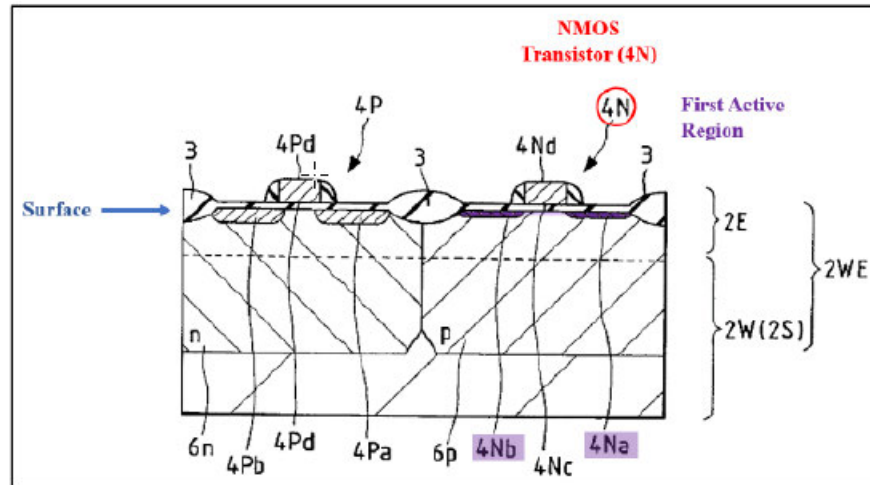
Ex. 1001, 4:54–5:5, 4:63–67, 6:9–13, 6:20–32.

We address each disputed limitation below.

i. “first active region . . . with a second doping type opposite in conductivity to the first doping type”

Petitioner contends that Kawagoe discloses “semiconductor regions 4Na and 4Nb” that are used “for forming the **source-drain regions** of the nMOS [n-channel transistor] 4N.” Pet. 13–14 (citing Ex. 1007, 3:30–37, 8:46–67, 14:46–55, 15:26–40) (modifications and emphasis by Petitioner).

Annotated Figure 23 of Kawagoe is reproduced below:



Referring to annotated Figure 23 above, Petitioner contends that source-drain regions 4Na/4Nb, in conjunction with the channel region, form part of the claimed first active region. *See* Pet. 14 (citing Ex. 1007, 8:46–65, 14:46–55, 15:26–40; Ex. 1003 ¶ 81; Ex. 1008B, 299–300). Petitioner asserts that, because regions 4Na and 4Nb are doped with a n-type impurity they have a second doping type (n-type) opposite in conductivity to the first doping type (p-type) of the substrate. *See id.* (citing Ex. 1007, 8:67–9:3, 14:46–55, 15:26–40; Ex. 1003 ¶ 81).

Patent Owner contends that Petitioner’s mapping of claim elements fails because the channel region between source-drain regions 4Na/4Nb is doped p-type, which is the same doping type that Petitioner identified for the first doping type of the first active region. *See* PO Resp. 35–37 (citing Pet. 13–14, 18–20, 23–26; Ex. 2064 ¶¶ 34–37, 63).

In Reply, Petitioner argues that Patent Owner’s argument is based on an unsupported narrow interpretation of the claim language. *See* Pet. Reply 22. Petitioner contends this “assumption defies the plain language of the claims, which simply calls for ‘a first active region . . . *with* a second doping type.’” *Id.* (alteration by Petitioner). Petitioner asserts that the plain

language of claims is consistent with Figures 5B and 5C of the '014 patent, which Patent Owner asserted “clearly disclose[]” the “claimed invention” and depict a NMOS having n-type source and drain and a p-type substrate. *See id.* at 22–23 (reproducing Ex. 1001, 5B, 5C; citing PO Resp. 4; Ex. 2064 ¶ 34) (alteration by Petitioner). Petitioner further argues that Kawagoe describes a CMOS device that has both the NMOS device *and* an adjacent PMOS transistor 4P having source and drain regions 4Pa, 4Pb formed with an n-type channel in n-type well 6n. *See id.* at 24 (reproducing Ex. 1007, Fig. 23 (with Petitioner’s added annotations); citing Ex. 1007, 9:40–54, 17:50–54, 18:15–23, 21:55–61).

Based on the complete record developed during trial, including the express disclosures of the '014 patent, we determine that Petitioner demonstrates that Kawagoe discloses a “first active region ... with a second doping type opposite in conductivity to the first doping type.” Pet. 13–14 (citing Ex. 1007, 3:30–37, 8:46–67, 14:46–55, 15:26–40; Ex. 1003 ¶ 81; Ex. 1008B, 299–300, 382, 387 Figs. 5-2, 6-8(c), 6–10; Ex. 1008C, 525, Fig. 8-1(e)). Petitioner demonstrates that the active region of a transistor includes the source, drain, and channel region between them. *See id.* at 14. For example, Wolf’s textbook states that “[t]he active regions are those in which transistor action occurs; i.e., the channel and the heavily doped source and drain regions.” Ex. 1008B, 299. This first active region of Kawagoe has two types of dopants; the source and drain are doped n-type and the channel is doped p-type. *See* Ex. 1007, Fig. 23. The first doping type identified by Petitioner is that of the p-well, or p-type dopants. *See* Pet. 8–13. Thus, the active region has “a second dopant type” (n-type) that is opposite in conductivity to the “first doping type” (p-type). We discern nothing in the language of the claims or in the written description of the '014

patent that would require that the “second dopant type” be the only type of dopant in the “first active region,” and the configuration relied upon by Petitioner conforms to that depicted in Figures 5B and 5C of the ’014 patent, which Patent Owner asserts disclose the claimed invention. *See* PO Resp. 6 (“The claimed invention is clearly disclosed in, e.g., Figs. 5B-5C of the Challenged Patent, and the corresponding parts of the specification.”). Accordingly, Petitioner demonstrates that Kawagoe discloses a “first active region . . . with a second doping type opposite in conductivity to the first doping type,” as recited in claims 1 and 21.²¹ Ex. 1001, 4:54–57, 6:10–14.

ii. “*graded dopant concentration to aid carrier movement*”

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/surface] [towards/to] an area of the substrate where there are no active regions.” Ex. 1001, 4:63–67, 6:21–25. Petitioner contends that Kawagoe’s Figure 17 illustrates the doping concentration from a top surface of the substrate and the channel region, and shows that “the dopant concentration is ‘gradually lowered in the depthwise direction *from the principal surface* (having an impurity concentration NW) of the epitaxial layer 2E.’” Pet. 19 (reproducing Ex. 1007, Figs. 17, 23 (with Petitioner’s annotations added); quoting Ex. 1007, 15:62–16:40 (emphasis by Petitioner)). According to

²¹ For example, there is no limitation in claims 1 and 21 that would require the first active region to have a “conductivity” that is opposite than the substrate (containing the first doping type). Rather, it is the second doping type that must be opposite in conductivity to the first doping type, and there is no dispute that the n-type dopants of the source and drain are opposite in conductivity to the p-type dopants in the channel region and p-well.

Petitioner, “[t]he dopant concentration is thus graded in the channel region of transistor 4N, which is a portion of the first active region formed at ‘the principal surface’ of epitaxial layer 2E.” *Id.* (citing Ex. 1003 ¶ 91); *see also id.* at 24–25 (noting the same dopant configuration for pMOS transistor 4P, i.e., the second active region, citing Ex. 1007, 15:62–16:2). Petitioner contends that Kawagoe explains that the downward-sloping graded dopant concentration aids the movement of carriers from the first and second active regions towards the bottom of the substrate where there are no active regions. *See id.* at 21 (citing Ex. 1007, 16:2–11), 24–25 (citing Ex. 1007, 16:2–11); *see also id.* at 21–22 (asserting that the downward-sloping graded dopant concentration aids the movement of carriers from the surface to deeper parts of the substrate where there are no active regions, citing Ex. 1007 16:2–11; Ex. 1009, 431, Fig. 2; Ex. 1003 ¶¶ 94–95).

Claims 1 and 21 also require “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, 5:1–5, 6:26–30. Petitioner contends that Kawagoe discloses “p-well 6p” that is adjacent to a first active region and discloses that the dopant concentration in p-well 6p gradually decreases with depth. *See* Pet. 23–24 (reproducing Ex. 1007, Figs. 17, 23 (with Petitioner’s annotations added); citing Ex. 1007, 8:66–67, 14:46–55, 15:26–40, 15:62–16:40; Ex. 1003 ¶¶ 99–101).

Petitioner further contends that Kawagoe explains that the downward-sloping graded dopant concentration aids carrier movement from the surface of the epitaxial layer towards/to the area of the substrate where there are no active regions. *See id.* at 24 (citing Ex. 1007, 16:2–11).

Although Kawagoe discusses electrons near the surface of or inside the substrate, Petitioner presents evidence that single event upsets, such as those caused by an α -ray strike, may also occur in both the channel and the source/drain regions of a transistor. *See* Pet. 21–22 (citing Ex. 1009, 431, Fig. 2; Ex. 1003 ¶¶ 94–95). In particular, Dr. Blalock testifies that “[d]uring a so-called single event upset (SEU), an α -ray generates millions of carriers, some of which are provided in or near the active region at the top surface of the substrate.” Ex. 1003 ¶ 95 (citing Ex. 1009, 431 (“A particle can induce SEU when it strikes at the channel region . . . of [a] transistor.”)). Petitioner contends that when such electrons are produced in Kawagoe, the downward sloping gradient will aid the movement of such carriers from the active regions near the surface downward to the substrate where there are no active regions. *See* Pet. 21–22 (citing Ex. 1009, 431, Fig. 2; Ex. 1007, 16:2–11; Ex. 1003 ¶¶ 94–95), 24–25 (citing Ex. 1007 16:2–11; Ex. 1016, 289–290; Ex. 1003 ¶¶ 101–102).

Petitioner contends that this conclusion is confirmed by Applicant’s express statements made during prosecution of parent U.S. Pat. No. 8,421,195 (“the ’195 patent” or “the parent ’195 patent”). *See* Pet. 25–27 (reproducing Ex. 1010, Figs. 1a, 1b (with Petitioner’s annotations added); Ex. 1031, Fig. 3 (with Petitioner’s annotations added); citing Ex. 1010, 2:27–32, 5:14–22; Ex. 1016, 237–38, 286, 289–90; Ex. 1020, 2, 29, 30; Ex. 1031, 3:6–13, Fig. 2; Ex. 1036; Ex. 1003 ¶¶ 101–103). For example, during prosecution of the ’195 patent, the Applicant presented claims requiring a “drift layer having a graded concentration of dopants extending between said surface layer and said substrate to create a unidirectional drift field drawing all minority carriers from said surface layer to said substrate.” Ex. 1016, 234 (emphasis omitted). These claims were

rejected under 35 U.S.C. § 112, first paragraph, with the Examiner asserting that although the specification was enabling for “a unidirectional drift field,” it did “not reasonably provide enablement for ‘drawing all minority carriers from said substrate to said surface layer.’” *Id.* at 269. The Examiner explained that “[i]t is not clear if simply the application of ‘a unidirectional drift field’ is sufficient to achieve the effect of ‘drawing all minority carriers from said substrate to said surface layer.’” *Id.* at 270. According to the Examiner, “[i]n a complex electronic device, movement of minority carriers is affected by multiple forces and fields . . . [and] 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.’” *Id.*

In rebutting the Examiner’s rejection, the Applicant argued:

[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).

Ex. 1016, 289. In response to the Examiner’s assertion that “the application of ‘a unidirectional drift field’ “does not appear to ensure (without knowing [the] other parameters of the device) that it will draw ‘all’ minority carriers” from the surface layer to the substrate” (*id.* at 270), the Applicant asserted that this argument

appears to not consider that the graded dopant concentration itself creates a “built-in” electrical field that forces the movement of carriers into a particular direction, whereby the “direction” of the electrical field and the resulting direction of the carrier movement depends solely on the slope of the graded concentration of 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 (emphasis added). Along with this argument, the Applicant amended its claims to remove the requirement that the drift field “draw[] all” minority carriers from said surface layer to said substrate, and replaced it with “to aid the movement of minority carriers from said surface layer to said substrate.” *Id.* at 286. The Examiner thereafter dropped the § 112, first paragraph rejection and, after one further set of amendments, allowed the claims. *Id.* at 301, 315–17, 330–34, 345–47.

In this proceeding, Patent Owner reverses course and contends a “‘graded concentration of dopants’ does not inherently ‘aid carrier movement.’” PO Resp. 11. Patent Owner reasons that the claims require movement of carriers and there may be other forces in play within a transistor that affect such movement. *See id.* at 3, 11–17. Consistent with the testimony of its witness, Dr. Glew, Patent Owner contends that Dr. Blalock testified on cross-examination that the carrier moves according to the net force — the magnitude of the force of a dopant gradient as well as other forces. *See id.* at 3–4 (citing Ex. 2058, 188:16–189:16), 11–13 (citing Ex. 1016, 270; Ex. 2058, 137–138), 14 (citing Ex. 2058, 187–188), PO Sur-reply 9–10 (citing Ex. 2058, 187:8–188:14). According to Patent Owner,

if two forces are acting on an object in opposite directions, both forces cannot aid its movement. . . . Either the opposing forces are equal—and there is no movement—or the two forces are not equal and the object moves in the direction of the larger force, albeit diminished by the counter force.

Id. at 13 (citing Ex. 2064 ¶¶ 52–55). Patent Owner contends that Dr. Glew testifies that the inherent resistance of silicon also affects carrier movement. PO Resp. 14 (citing Ex. 2064 ¶¶ 54, 90, 101, 104. According to Patent Owner, “Dr. Glew and the specification also show that the slope of the dopant concentration is a relevant parameter for determining whether a concentration gradient will aid carrier movement.” *Id.*; *see id.* at 15 (citing Ex. 2072, 2:66–3:15; Ex. 2064 ¶¶ 53–61). Patent Owner asserts that Dr. Campbell’s testimony, proffered by petitioner Monolithic Power Systems in parallel IPRs (i.e., IPR2024-00468, 00469, 00470), “confirms that ‘graded’ is not inherently ‘aided’” on the basis of Dr. Campbell’s testimony “that only a gradient generating a ‘properly constructed’ electric field would aid carrier movement” and identification of other factors that affect carrier movement, for example, capacitance created by a PN junction, temperature, and imperfections in silicon lattice structure. *See* PO Resp. 4 (citing Ex. 2085, 34:1–14; Ex. 2086 ¶ 32), 15 (citing Ex. 2085, 33:14–34:19, 39:8–12). Patent Owner further asserts that a petitioner in co-pending proceedings (i.e., IPR2024-00001, -00016 through -00021) admitted that a graded dopant concentration does not inherently aid carrier movement based on its corporate representative Scott Warrick’s testimony that “there’s a long list of . . . physical attributes which affect the movement of carriers” “and “one could not tell based solely on the presence of a graded dopant concentration that the gradient would “aid carrier movement.” *See* PO Resp. 4 (citing Ex. 2083, 72:6–8, 95:2–5, 96:1–13), 15–16 (citing Ex. 2083, 72:6–8, 95:2–5,

96:1–13), 32–33 (citing Ex. 2083, 72:6–8, 95:2–5, 96:1–13).

Patent Owner also contends that,

during prosecution [of the parent '195 patent], 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. This is exactly what Petitioner’s expert, Cirrus Logic’s 30(b)(6) witness, and Greenthread’s expert testified.

Id. at 16 (citing Ex. 1016²², 270; Ex. 2064 ¶¶ 52–54, 90, 97, 101).

We do not agree with Patent Owner’s arguments. Although there may be myriad forces acting upon carriers in a transistor, the Applicant made clear during prosecution of the parent '195 patent that the “aid carrier movement” limitation did not require an analysis of these parameters, and the '014 patent does not mention such forces or the need to account for them. *See* Ex. 1016, 289–90. Rather, as stated during prosecution of the '195 patent, “a unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way – moving all minority carriers in the same direction”, “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,” and “this inherent ‘built-in’ unidirectional electric field . . . ensur[es] that all minority carriers are being moved in one direction.” *Id.* The public was entitled to rely upon these clear and unambiguous assertions regarding the effect of a graded dopant

²² Petitioner incorrectly cited Exhibit 1002.

concentration and unidirectional drift field when considering the scope of the challenged claims. *See 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.”). Thus, evidence of a sloping dopant concentration gradient that creates a unidirectional drift field in the appropriate location and pointing in the appropriate direction is sufficient to demonstrate the “aid carrier movement” limitation of the claims. *See* Ex. 1020, 37 (Patent Owner’s counsel representing before the district court that “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.”). Although Patent Owner proffers testimony (e.g., Ex. 1016, 270; Ex. 2058, 137–138, 187:8–189:16; Ex. 2064 ¶¶ 52–55, 90, 97, 101, 104; Ex. 2083, 72:6–8, 95:2–5, 96:1–13; Ex. 2085, 33:14–34:19, 39:8–12; Ex. 2086 ¶ 32) that is generally consistent with both Patent Owner’s arguments in this proceeding and the Examiner’s initial assertion during prosecution of the parent ’195 patent, the Applicant expressly stated during prosecution that this reasoning was incorrect in view of the scope of the claims. *See* Ex. 1016, 289–90. As such, we find that the testimony of Dr. Glew, Dr. Blalock, Dr. Campbell, and Mr. Warrick does not evidence that a sloping dopant concentration gradient in the appropriate direction and location will not necessarily aid the movement of carriers.

Patent Owner further contends that “[f]inding that any gradient satisfies the ‘aid movement’ claim [phrase] also goes against the plain language of the claim.” PO Resp. 17; *see id.* at 2–3 (arguing that it is wrong

to read “aid carrier movement from the first surface” out from the claim), 10 (arguing improper collapsing of the terms). According to Patent Owner, “[i]f any ‘graded dopant concentration’ would ‘aid carrier movement,’ then there was no reason to include the separate claim [phrase],” which “‘strongly implies’ that a ‘graded dopant concentration’ ‘does not inherently’ ‘aid carrier movement.’” *Id.* at 17–18; *see id.* at 10 (similar argument).

We disagree. The phrase “to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions” is not superfluous as it indicates the direction and area in which the graded dopant concentration must aid carrier movement (from the first and second active regions or at least one well region to the area of the substrate where there are no active regions). Thus, we find that the use of both terms “graded” and “aided” does not imply that a “‘graded dopant concentration’ does not inherently ‘aid carrier movement,’” as argued by Patent Owner.

Patent Owner also contends that the Applicant’s statements during prosecution have been misconstrued. *See* PO Resp. 21. Patent Owner asserts that its argument during prosecution was that movement of carriers “[d]epend[s] on the particular slope of the graded concentration of dopant[s]” and that it was responding to an Office Action regarding a claim that required a “single static unidirectional electric drift field to aid the movement of carriers,” which was an “additional parameter” that ensured “that all minority carriers are moved in one direction.” *Id.* (citing Ex. 1016, 286, 289–90).

We do not agree. Contrary to Patent Owner’s arguments, the Applicant stated during prosecution that “the graded dopant concentration itself creates a ‘built-in’ electrical field that forces the movement of carriers

into a particular direction,” and this direction “depends solely on the slope of the graded concentration of dopant.” Ex. 1016, 289–90. Thus, the graded dopant concentration creates the “additional parameter” that ensures that “all minority carriers are moved in one direction.” *Id.*

Patent Owner contends “Petitioner’s apparent position that *any* gradient aids carrier movement leads to absurd results that are plainly inconsistent with the claim language.” PO Resp. 18; *see id.* at 10 (similar argument). According to Patent Owner, “Petitioner’s ‘graded’ entails ‘aided’ assumption (or claim construction) implies that a gradient can ‘aid’ movement of carriers that do not move at all.” *Id.* at 18; *see id.* at 10 (similar argument). And, as noted above, Patent Owner contends that an assumption that a graded dopant concentration will necessarily aid carrier movement is inconsistent with the Examiner’s assertions during prosecution of the parent ’195 patent, witness testimony, and at least two district courts’ conclusions. *See id.* at 3–4, 10, 17–21.

The Examiner’s assertions and the Applicant’s responses during prosecution of the parent ’195 patent, are addressed above. Patent Owner’s arguments before the district courts are addressed below.

Patent Owner contends that “[n]ot one but two District Courts have previously agreed with [Patent Owner] that not *all* doping gradients aid carrier movement.” PO Resp. 18. In particular, Patent Owner contends the Western District of Texas “unequivocally stated, ‘a graded concentration . . . that is [not ‘sufficiently graded’] will not aid in the movement of minority carriers[.]’” *Id.* at 18–19 (citing Ex. 2080, 39–40) (alterations by Patent Owner); *see id.* at 10 (citing Ex. 2080, 39–40). “And 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 19 (citing Ex. 2082, 15 (Patent Owner arguing that a cited reference “explain[s] 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’”) (first alteration added)); *see id.* at 10 (citing Ex. 2082, 15).

Before the Western District of Texas, Petitioner (Cirrus Logic) asserted that the term “graded dopant concentration” was indefinite, as it was unclear where the boundary between “graded” and “uniform” doping concentrations would be. *See* Ex. 2080, 32. Patent Owner argued in response that the ’195 patent provides sufficient guidance as to the meaning of the claim term, with “graded” meaning varying or not “uniform.” *Id.* at 37–38 (“Greenthread contends that Figure 1 in the ’195 Patent depicts the difference between uniform and graded concentrations, namely, that the concentration in the former is the same across a region while in the latter, the concentration has a slope.”). The District Court determined that the term was not indefinite for multiple reasons and that “graded” “describes a sloped doping concentration.” *Id.* at 39–41. According to the court, “a person of skill would understand that the graded concentration has to be sufficiently graded to result in a ‘static unidirectional electric drift field to aid the movement of minority carriers,’ as recited in claim 1 of the ’195 patent. *Id.* at 39–40.

We do not agree with Patent Owner’s arguments because we discern no finding in the court’s 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.” First, the court did not address the same argument raised by Patent Owner in this proceeding. Rather, the court addressed whether the term

“graded dopant concentration” is indefinite. *See* Ex. 2080, 32–41. Second, the court’s 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 the parent ’195 patent claims (*see id.* at 39–40), which, as the Applicant argued during prosecution and in its claim construction brief before the Western District of Texas, would “aid in the movement of minority carriers.” *See id.* at 38 (“Greenthread contends that the claims specify that the graded dopants generate an electric field that aids in the movement of minority carriers.”); Ex. 1020, 35–36 (“[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 (“[T]he intrinsic record consistently confirms that the electric fields aid the movement of the carriers.”).

Before the Eastern District of Texas, the parties disputed the proper construction of the term “single drift layer . . . having a graded concentration of dopants generating a first static unidirectional drift field.” Ex. 2082, 10 (alteration in original). Patent Owner asserted that no construction was necessary, whereas the defendant argued that the term should be construed as a “single layer whose concentration of dopants either increases across the layer or decreases across the layer.” *Id.* The court explained that the dispute distilled into two issues: (1) whether the graded concentration of dopants could only increase or decrease; and (2) whether the “single drift layer” is necessarily a single layer. *See id.* at 13–14.

In addressing the question of whether the graded concentration of dopants could both increase and decrease in the drift layer, the court rejected the defendant’s suggestion that the prosecution statement that the direction

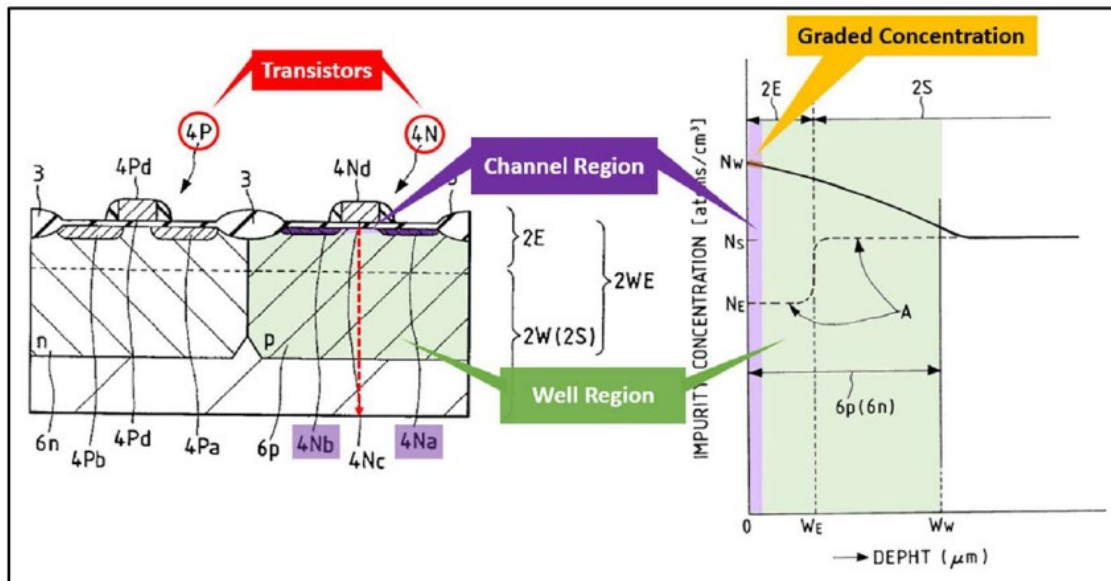
of the electrical field and the carrier movement “depends solely on the slope of the graded concentration of dopant” demonstrates that “the slope must be only increasing or only decreasing to maintain a unidirectional drift field.” Ex. 2082, 15. In rejecting this argument, the court found that the Applicant 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 and *Grove*,” relied upon by the Applicant during prosecution, “discloses a dopant concentration that both increases and decreases in the drift layer.” *Id.* at 15–16. Contrary to Patent Owner’s arguments, the court’s conclusion regarding the scope of the claims is 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 . . . carriers in a single direction.” *Id.*

In view of the foregoing, we determine that Petitioner and the public at-large were entitled to rely upon the Applicant’s statements during prosecution that a graded dopant concentration itself will create a unidirectional electric drift field in a particular direction and this field will “aid carrier movement.” *See* Ex. 1016, 289–90.

Patent Owner further contends that Petitioner’s arguments addressing the prior art fail because “it restricts its analysis to the direction of the gradient—and nothing else.” PO Resp. 22–23. Patent Owner asserts these arguments are deficient because (1) the Petition fails to consider the relevant factors that affect carrier movement; (2) Kawagoe’s concentration gradient actually impedes carrier movement; (3) Kawagoe’s carriers are not in the active region; (4) Petitioner relies upon a post-priority date reference to make up for Kawagoe’s deficiency; and (5) carriers generated by alpha-ray

strikes are not at the “surface” or in the “active regions” of semiconductor devices. *See id.* at 17, 22–32. We address these arguments in turn.

As discussed briefly above, Petitioner demonstrates that Kawagoe discloses a downwardly sloping dopant gradient that extends from the top surface of the substrate (and active regions) to the bottom surface. *See* Pet. 18–19. This is depicted in the annotated figures reproduced below:



Figures 23 (left) and 17 (right) are annotated by Petitioner to show the regions in which the gradient concentration is lowered in a depthwise direction. As Figure 17 shows, the dopant concentration is “gradually lowered in the depthwise direction from the principal surface (having an impurity concentration N_w) of the epitaxial layer 2E” to and through the substrate W_w . Ex. 1007, 15:67–16:2. Dr. Blalock testifies that this downward-sloping graded dopant concentration aids carrier movement from the first and second active regions towards the bottom of the substrate where there are no active regions. Ex. 1003 ¶¶ 94, 98. As highlighted in the preceding analysis, the Applicant was clear during prosecution of the parent ’195 patent that the graded dopant concentration itself creates a ‘built-

in' electrical field that forces the movement of carriers into a particular direction, and that a unidirectional electric field will "necessarily" aid carrier movement, and other potential forces present in the transistor need not be considered. Ex. 1016, 289–90. Indeed, Dr. Glew confirmed that it is "just basic physics" that an electric field will aid movement in the direction of the force and Patent Owner has confirmed this conclusion during district court proceedings. Ex. 1056, 108:15–23 (Dr. Glew testifying that "a field will provide a force in a direction aiding – direction – aiding movement in the direction of the force. That's just basic physics."); Ex. 1020, 35–36 ("Electric drift fields are a well-known phenomenon that cause carriers to move, and 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."). Thus, we find that Petitioner demonstrates that Kawagoe discloses the limitation: "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." Ex. 1001, 4:63–67.

To the extent other factors within the transistor were relevant to the inquiry, Patent Owner identifies no force in Kawagoe that it contends could overwhelm or negate the electric field created by the downward sloping gradient of Kawagoe.

Patent Owner further contends that Kawagoe's disclosure that the dopant gradient is designed such that "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" (Ex. 1007, 16:7–9) demonstrates that Kawagoe's graded dopant concentration actually inhibits carrier movement

into the relevant area of the transistor. *See* PO Resp. 25–26 (citing Pet. 24; Ex. 1007, 16:2–11). Patent Owner reasons that “[s]ince Kawagoe teaches inhibiting carrier movement, it does not teach aiding carrier movement.” *Id.* at 26 (citing Ex. 2064 ¶¶ 54–58).

We do not agree with this argument because whether Kawagoe’s electric field aids or inhibits carrier movement simply depends on the location of the carrier. A carrier below the substrate will be inhibited from exiting the lower surface of the substrate and travelling towards the first surface of the substrate, whereas an electron carrier that exists in the active regions or well regions will be drawn by the electric field created by the graded dopant concentration towards the substrate where there are no active regions. *See* Pet.18–28; Pet. Reply 14 (“In other words, aiding downwards is consistent with inhibiting movement in the opposite direction.”); Ex. 1003 ¶¶ 90–107.

Patent Owner also contends that the carriers of Kawagoe are in the wrong place, i.e., generated below area 6p and prevented from entering it. *See* PO Resp. 24–27.

We do not agree with Patent Owner’s arguments for at least two reasons. First, the challenged claims are drawn to an apparatus. *See ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018) (“[A]pparatus claims cover what a device *is*, not what a device does.”). Thus, Petitioner need not demonstrate actual movement of carriers in Kawagoe, only that the device is capable of moving such carriers when they are present in the active regions. *See id.* (noting that “a prior art reference may anticipate or render obvious an apparatus claim— depending on the claim language—if 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”).

Second, Petitioner demonstrates that an α -ray generates millions of carriers some of which are produced in or near the active regions of the substrate. *See* Pet. 21 (citing Ex. 1003 ¶¶ 94–95; Ex. 1009, 431 (“A[n] [α -]particle can induce SEU when it strikes at the ***channel region*** of . . . [a] transistor.”)). Petitioner demonstrates that the graded dopant concentration of Kawagoe will direct these carriers from the active region or surface to the bottom of the substrate where there are no active regions. Ex. 1003 ¶¶ 90–107.

Patent Owner further contends that Petitioner relies upon a post-priority date reference²³ to demonstrate that α -ray strikes will generate carriers (electrons and holes) at the surface of the device. *See* PO Resp. 28. And, because the Petition relies upon post-priority date disclosures, Patent Owner contends that the “Petition contains no evidence that a POSITA would have known about SEU carriers in the active region at the time of the Challenged Patent.” *Id.*

We do not agree with this argument for multiple reasons. First, the apparatus claims at issue do not require actual movement of carriers, only the capability to move such carriers if present. *See ParkerVision*, 903 F.3d at 1361. Second, Petitioner’s challenge is based on Kawagoe alone, and not in combination with a non-prior art reference, and Petitioner demonstrates that the fact that α -ray strikes could generate carriers in the active region of a transistor was disclosed well-before the priority date of the ’014 patent.

²³ Ex. 1009, Wang et al., Single Event Upset: An Embedded Tutorial, 21st Int’l Conf. on VLSI Design, IEEE 2008 (“Wang”).

Pet. Reply 12–13 (citing Ex. 1056, 123:17–128:11; Ex. 2066, 19:41–42, 19:54–20:11, Figs. 34–36). Third, Patent Owner concedes that single-event upsets in the active region will occur, but just with a much lower probability than strikes in the bulk of the substrate. *See* PO Resp. 29–30.²⁴ Finally, Petitioner does not propose changing the configuration of Kawagoe in any way based on knowledge that SEUs will occur. *See* Pet. Reply 13 (“Petitioner is **not** proposing to modify Kawagoe in view of Wang.”). Thus, what a person of ordinary skill in the art would have understood about SEUs and generated carriers in the relevant time period does not affect whether Kawagoe’s graded dopant concentration is capable of aiding carrier movement.

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

²⁴ Nishizawa (Ex. 2066) explains that for an alpha-particle of 5 MeV, the probability of creating electron-hole pairs is extremely low near the surface, and the alpha-particle will begin to create electron-hole pairs after it has entered into the substrate a certain distance. Ex. 2066, 19:24–34. Thus, the number of electron-hole pairs in the region of the surface (to 0.8 μm from the surface) is about 1/50 or less the total number of electron hole-pairs that are created in the semiconductor body by a single alpha-particle. *Id.* at 19:34–41. Even at this reduced rate, however, “several ten thousand electrons” will flow into the active regions of the transistor from a single alpha-particle strike. *Id.* at 19:41–42. Nishizawa also explains that this number will increase when the angle of incidence is less than 90°, as this shifts electron-hole pair creation “towards and closer to the surface of the device.” *Id.* at 19:58–67.

c. Conclusion with Respect to Claims 1 and 21

Based on the complete record developed during trial, we determine that Petitioner 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 in view of 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 23 of Kawagoe is reproduced below:

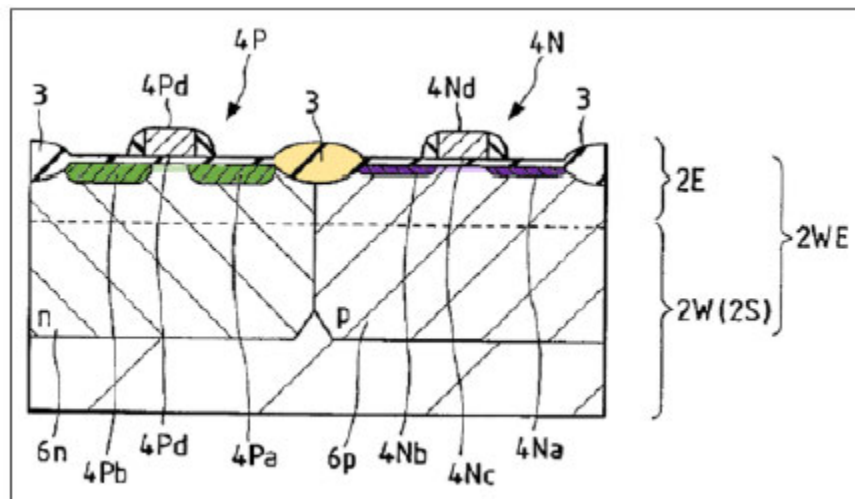


Figure 23 above contains colored annotations showing the first active region (purple), the second active region (green) and isolation region 3 (yellow).

See Pet. 32. Petitioner contends field insulating film 3 of Kawagoe is an isolation region that separates the first and second active regions. See *id.* at 31 (citing Ex. 1007, 8:40–52, 15:37–40, 17:62–18:8; Ex. 1008A, 818–20, Fig. 16-11(f); Ex. 1003 ¶ 116).

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. 38 (quoting Ex. 1007, 9:3–6; citing Ex. 1007, 8:66–67). Thus, according to Patent Owner, 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 38–39.

As depicted in Figure 23, field insulating film 3 physically separates the first and second active regions. Ex. 1007, Fig. 23. The plain language of the claims does not require that this film extend as deep as the first and second active regions, and Petitioner presents evidence that the depth of epitaxial layer 2E may vary. See Pet. Reply 26 (citing Ex. 1007, 8:36–40, 9:3–6, 9:47–53, 17:22–25). 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 27 (citing Ex. 1007, 8:43–45; Ex. 1056, 142:4–143:11).

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

4. Analysis—Dependent Claims 2–5, 7–9, 13, 14, 16–20, 22–26, and 28

Claims 2–5, 7–9, 13, 14, 16–20, 22–26, and 28 depend from either independent claim 1 and 21. Petitioner identifies where Kawagoe teaches or suggests every limitation of claims 2–5, 7–9, 13, 14, 16–20, 22–26, and 28. *See* Pet. 29–40. Patent Owner does not address Petitioner’s contentions with respect to claims 2–5, 7–9, 13, 14, 16–20, 22–26, and 28, apart from its arguments addressing independent claim 1. *See* PO Resp. 21–37.

Based on the complete record developed during trial, we determine that Petitioner demonstrates that Kawagoe teaches or suggests every limitation of claims 2–5, 7–9, 13, 14, 16–20, 22–26, and 28. Accordingly, we determine that Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 2–5, 7–9, 13, 14, 16–20, 22–26, and 28 would have been obvious in view of Kawagoe.

5. Conclusion

For the reasons set forth above, Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 1–9, 13, 14, and 16–28 would have been obvious in view of Kawagoe.

F. Patentability Challenge Based on Wieczorek and Wolf

Petitioner contends the subject matter of claims 1, 2, 4–9, 13–23, and 25–28 would have been obvious in view of the combined teachings of Wieczorek and Wolf. *See* Pet. 40–72.

1. Overview of Wieczorek

Wieczorek relates “to a semiconductor device, such as a field-effect transistor, having an improved retrograde dopant profile in a channel region of the transistor element.” Ex. 1006 ¶ 2. Wieczorek explains that a retrograde channel dopant profile is one where “the concentration of dopants

increases from the gate insulation layer to the areas located deeper down the channel region.” *Id.* ¶ 6. According to Wieczorek, although a retrograde channel dopant profile is desirable, it is “very difficult to obtain.” *Id.* Wieczorek notes that “the dopant concentration immediately after the implantation process exhibits a desired retrograde dopant profile” (*id.* ¶ 9), but during heat treatment, “the initially retrograde profile in the vicinity of the surface of the semiconductor device . . . may have become substantially uniformly distributed” due to diffusion of the dopant atoms (*id.* ¶ 11).

Petitioner relies on Figures 1b and 2b (reproduced below), which Wieczorek uses to illustrate the prior art.

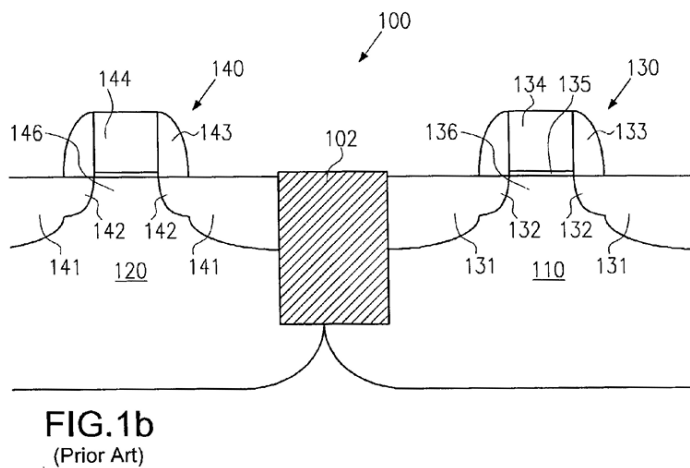


FIG. 1b
(Prior Art)

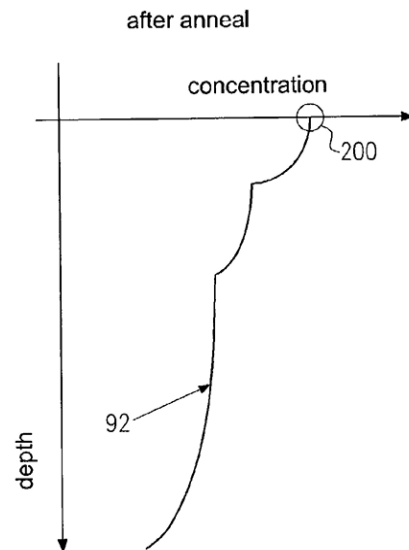


FIG. 2b
(Prior Art)

Wieczorek Figure 1b shows a conventional semiconductor device at an advanced manufacturing stage. *See* Ex. 1006 ¶¶ 12, 20. The device includes P-channel transistor 140 with source and drain regions 141 in n-well structure 120 and N-channel transistor 130 with source and drain regions 131 in p--well structure 110. *See id.* ¶ 12. Shallow trench isolation 102 separates n-well structure 120 from p-well structure 110. *See*

id. ¶ 7. Wieczorek Figure 2b is a graph of dopant concentration versus depth of n-well structure 120 and p-well structure 110 and shows “a typical dopant profile with respect to the depth of the respective well structure” after ion implantation and heat treatment. *See id.* ¶¶ 9–11, 13, 21.

2. Overview of Wolf

Wolf is a four-volume textbook titled “Silicon Processing for the VLSI Era.” Ex. 1008. A portion of the textbook focuses on CMOS technology. *See* Ex. 1008A, 807–40.

3. Analysis—Claim 1 and Independent Claim 21

a. Motivation to Combine

Petitioner relies on Wieczorek’s disclosure of the conventional prior art C-MOS device. *See* Pet. 40 (citing Ex. 1006 ¶¶ 4, 7–8, 12, 20–21, Fig. 1b). Petitioner contends that Wolf is “a well-known textbook,” and relies on Wolf for teaching “known fundamental features and concepts related to semiconductor manufacturing, with particular emphasis on CMOS devices.” *Id.* at 41 (citing Ex. 1008A, Chapter 16; Ex. 1003 ¶ 133). According to Petitioner, a person of ordinary skill in the art would have understood and expected that the teachings of Wolf would apply to Wieczorek’s conventional CMOS device, and would have looked to Wolf for additional details related to conventional CMOS devices. *See id.* (citing Ex. 1003 ¶ 133).

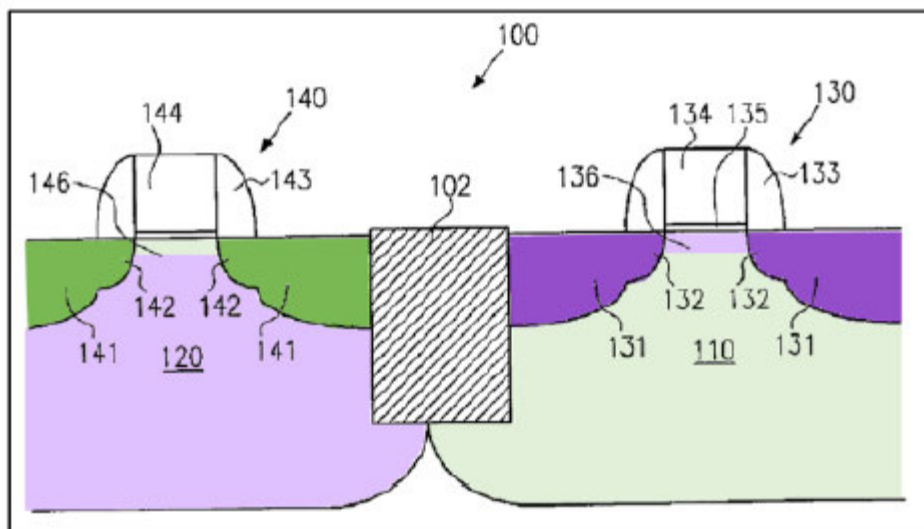
Patent Owner does not dispute Petitioner’s rationale for combining Wieczorek and Wolf. *See* PO Resp. 33–35. Based on Petitioner’s persuasive contentions and evidence, we determine that Petitioner establishes that a person of ordinary skill in the art would have had a reason

to combine the teachings of Wieczorek with those of Wolf with a reasonable expectation of success.

b. 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.”²⁵ Ex. 1001, 4:51, 6:4–6. To the extent the preamble is limiting, Petitioner contends that Wieczorek teaches or renders obvious a “semiconductor device 100” that constitutes an electronic system. *See* Pet. 41–42 (reproducing Ex. 1006, Fig. 1b); citing Ex. 1006 code (54) ¶¶ 4, 12, Ex. 1008B, 114; Ex. 1003 ¶¶ 134–135).

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 Wieczorek in combination with Wolf discloses this limitation. In support, Petitioner provides an annotated version of Figure 1b of Wieczorek, which is reproduced below.



²⁵ Petitioner uses bracketed language to show the differences between claims 1 and 21. Pet. 9 n.3. We use this convention as well.

Figure 1b is annotated to show N-channel transistor 130 (nMOS) with source/drain regions 131–132 (purple) and channel region 136 (light purple) formed in p-well 110 (light green). *See* Pet. 42–43 (citing Ex. 1006 ¶¶ 7, 12, 20–21; Ex. 1008C, 525, Fig. 8-1(e); Ex. 1003 ¶ 136). Figure 1b is also annotated to show P-channel transistor 140 (pMOS) with source/drain regions 141–142 (green) and channel region 146 (light green) formed in n-well 120 (light purple). *See id.* at 43.

Petitioner contends that Wieczorek explains that the p-well and n-well structures may be formed on any appropriate substrate, but does not explicitly specify what that substrate may be. *See* Pet. 43 (citing Ex. 1006 ¶¶ 4, 7; Ex. 1003 ¶ 137). Petitioner asserts, however, that a person of ordinary skill in the art consulting Wolf would have understood that a “*uniform*, lightly doped *p*- or *n*- type substrate” is commonly used in twin-well CMOS devices and one of ordinary skill in the art would have found it obvious to use such a substrate in Wieczorek because “[d]oing so would amount to combining known prior art elements . . . according to known methods . . . to obtain predictable results.” *Id.* at 43–44 (citing Ex. 1008C, 523, 530; Ex. 1008B, 387–389; Ex. 1003 ¶¶ 138–139); *see id.* at 44 (asserting that the proposed combination would also be obvious to try because it “involves nothing more than choosing one of a finite number of known appropriate substrates that are described by Wolf as suitable for use in forming a twin-well CMOS device like Wieczorek’s”). Petitioner further contends that Wieczorek-Wolf’s substrate is a p-type non-epitaxial substrate which has a surface. *Id.* (reproducing Ex. 1006, Fig. 1b (with Petitioner’s annotations added); citing Ex. 1008A B, 382, Figs. 6–8(c); Ex. 1008C, 525, Fig. 8-1(e); Ex. 1003 ¶ 140).

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 Wieczorek discloses an nMOS “transistor 130 that includes ‘heavily N-doped *source and drain regions* 131, including lightly doped extensions 132’ and ‘*channel region* 136.’” Pet. 46 (citing Ex. 1006 ¶¶ 4, 12–13); *see* Ex. 1006, Fig. 1b. Petitioner further contends that nMOS transistor 130 is formed in the surface of the first active region, which is adjacent the surface of the substrate, and because the source-drain regions are N-doped the first active region has a second doping type that is opposite in conductivity to the first doping type (P-type). *Id.* at 47 (reproducing Ex. 1006, Fig. 1b (with Petitioner’s annotations added); citing Ex. 1006 ¶¶ 7, 12; Ex. 1003 ¶¶ 142–143). Petitioner further contends Wieczorek teaches forming multiple transistors in its active regions. *Id.* (citing Ex. 1006 ¶ 4; Ex. 1003 ¶ 144; Ex. 1014, 1:52–54, 2:17–21).

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 pMOS transistor 140 of Wieczorek includes heavily P-doped source and drain regions 141, lightly doped extensions 142, and channel region 146, which are part of the claimed second active region. *See* Pet. 49 (citing Ex. 1006 ¶¶ 4, 7, 12–13; Ex. 1003 ¶ 147); Ex. 1006, Fig. 1b. Petitioner further contends that this second active region is disposed adjacent the first active region and that one or more transistors, such as P-channel transistor 140, may be formed in the surface of this second active region. *See* Pet. 49–50 (reproducing Ex. 1006 Fig 1b

(with Petitioner’s annotations added); citing Ex. 1006 ¶¶ 4, 7, 12; Ex. 1003 ¶¶ 148–149).

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, “Wieczorek’s ‘complementary MOS transistor pair’ is ‘a frequently used semiconductor device in modern integrated circuits’ and was understood by a POSITA to form digital logic gates.” Pet. 58 (citing Ex. 1006 ¶¶ 7, 26; Ex. 1008A, 810-811; Ex. 1003 ¶ 164).

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, as shown in Figure 2b, the graded dopant concentration is a combination of linear or nearly linear (quasilinear) segments. *See* Pet. 58–59 (reproducing Ex. 1006, Fig. 2b (with Petitioner’s annotations added); citing Ex. 1003 ¶ 165).

Patent Owner does not dispute Petitioner’s contentions that Wieczorek and Wolf teaches or suggests the aforementioned undisputed limitations of claims 1 and 21. *See* PO Resp. 33–35. Based on the complete record developed during trial, we determine that Petitioner demonstrates that Wieczorek and Wolf teaches or suggests the aforementioned undisputed limitations of claims 1 and 21.

c. 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 the doping concentration of transistor 130 (including the channel region and well region) in Wieczorek is shown in Figure 2b (reproduced above), and shows a dopant concentration that is highest at the surface of the substrate and decreases with depth. *See* Pet. 51–53 (reproducing Ex. 1006, Figs. 1b, 2b (with Petitioner’s annotations added; citing Ex. 1006 ¶¶ 4, 8, 9, 11–13, Fig. 2a; Ex. 1008B, 298–301, Fig. 5-2; Ex. 1003 ¶¶ 152–154), 56–57 (reproducing Ex. 1006, Figs. 1b, 2b (with Petitioner’s annotations added); citing Ex. 1006 ¶¶ 9, 11–13; Ex. 1003 ¶¶ 160, 162)). Petitioner further contends that Wieczorek’s downward-sloping graded dopant concentration aids carrier movement from the first and second active regions towards/to an area of the substrate in which there are no active regions to the same extent that Patent Owner/Applicant relied on the prior art and admitted, during prosecution of the parent ’195 patent, that a downward downward-sloping graded dopant concentration was known in the prior art to move carriers deep into the substrate. *See id.* at 54 (citing Ex. 1003 ¶ 155; Pet. 23–28 (§ VII.A.1.h.)); 57 (citing Ex. 1003 ¶ 161; Pet. 23–28 (§ VII.A.1.h.)).

Patent Owner contends the “Petition’s Wieczorek grounds fail for similar reasons as the Kawagoe grounds.” PO Resp. 33. According to Patent Owner, “Wieczorek does not have a graded dopant concentration in the active region” and “nothing in Wieczorek discusses using grading to affect carrier movement.” *Id.*; *see* PO Sur-reply 11 (arguing that Wieczorek does not mention moving carriers). Patent Owner further contends that

“Wieczorek says that in the active region the dopant concentration is uniform.” PO Resp. 1; *see id.* at 33 (arguing Wieczorek discloses the doping profile in the vicinity of the surface of the semiconductor device 100, as indicated by reference number 200, may have become substantially uniformly distributed, citing Ex. 1006 ¶ 11); PO Sur-reply 11–12 (citing Ex. 1006 ¶ 11), 12 (arguing that “the line in reference 200 appears just as straight as the horizontal ‘straight’ as the horizontal straight line above it,” and that when Wieczorek’s “specification refers to the line as ‘uniform’ . . . , Petitioner cannot possibly meet its burden by relying on [image] reproducti[on] glitches to argue otherwise.”). Patent Owner also faults Dr. Blalock for not calculating the slope of the graded concentration curve in Wieczorek. *See* PO Resp. 34 (citing Ex. 2058, 195).

In Reply, Petitioner counters that “Wieczorek does not say that the graded dopant concentration in the active region is uniform,” rather “[w]hat Wieczorek says is that the area near the surface indicated by number 200 ‘may have become substantially uniformly distributed’ *after annealing*.” Pet. Reply 19 (citing Ex. 1006 ¶ 11) (emphasis added). Petitioner argues “Figure 2b itself, however, confirms that ‘substantially uniform’ does not mean ‘uniform,’ as the distribution in area 200 remains non-uniform, i.e., the line is not straight.” *Id.* at 19–20 (reproducing an excerpt of Ex. 1006, Fig. 2b; citing Ex. 1006, Fig 2b); *see* Ex. 1061, 18 (“If there is zero slope, the line is flat. On the other hand, if there is slope, the line goes up or down (*i.e.*, it varies or changes).”). According to Petitioner, “[a]rea 200 is also not coextensive with the active region in Wieczorek. Figure 2a (showing elements 124, 123, 122, and 121) and Figures 1a and 1b (showing same) provide perspective on the relative depth of area 200 compared with the source and drain regions (e.g., 141, 131).” Pet. Reply 20–21 (reproducing

Ex. 1006, Figs 1a, 1b, 2a, 2b). Petitioner argues that “area 200 is shown *to occupy only a small portion of the active region.*” *Id.* at 21 (emphasis added). Petitioner further contends that Patent Owner’s additional arguments concerning Wieczorek “fail for the same reasons” as those concerning Kawagoe. Pet. Reply 21–22 (citing Ex. 1056, 32:15–33:25, 56:20–62:15, 69:3–71:9, 75:15–23, 83:17–89:13, 92:2–94:1, 102:2–109:14, 109:25–116:3, 120:11–123:15, 147:4–151:15, discussing the graded dopant concentration creating electric fields, unidentified forces (net forces), and particular slope).

We agree with Petitioner and find that Wieczorek teaches or at least fairly suggests a graded (sloped) dopant concentration within at least a portion of an active region that would aid carrier movement from the first surface to the second surface of the substrate. *See* Ex. 1006 ¶¶ 4, 9, 11–13; Figs 1a, 1b, 2a, 2b). Patent Owner’s counter-arguments regarding “to aid carrier movement” are unavailing for the same reasons discussed above with respect to Kawagoe.

For the reasons set forth above, based on the complete record developed during trial Petitioner demonstrates that the combination of Wieczorek and Wolf teach or suggest the disputed “graded dopant concentration to aid carrier movement” limitations of claims 1 and 21. *See* Pet. 51–58. Petitioner also provides a persuasive, undisputed rationale as to why one of ordinary skill in the art would have sought to combine Wieczorek and Wolf. *See id.* at 40–41 (asserting that Wolf is a “well-known text book” and one of ordinary skill in the art would have “understood and expected that the teachings of Wolf would apply to Wieczorek’s conventional CMOS device”).

d. Conclusion with Respect to Claims 1 and 21

Based on the complete record developed during trial, we determine that Petitioner demonstrates that the combination of Wieczorek and Wolf teaches or suggests every limitation of claims 1 and 21. Petitioner also provides a persuasive explanation as to why a person of ordinary skill in the art would have applied the CMOS manufacturing features and concepts for maintaining a retrograde dopant profile of Wolf to Wieczorek's conventional CMOS devices. *See* Pet. 40–41. 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 in view of the combined teachings Wieczorek and Wolf.

4. Analysis—Dependent Claims 2, 4–9, 13–20, 22, 23, and 25–28

Petitioner contends the subject matter of dependent claims 2, 4–9, 13–20, 22, 23, and 25–28 would have been obvious in view of Wieczorek and Wolf. *See* Pet. 59–72. In support of its arguments, Petitioner identifies where these references teach or suggest every limitation of these claims. *Id.* Patent Owner does not address Petitioner's arguments with respect to these dependent claims, apart from the arguments addressing independent claim 1. *See e.g.*, PO Resp. 33–35.

Based on the complete record developed during trial, we determine that Petitioner demonstrates that the combination of Wieczorek and Wolf teaches or suggests every limitation of dependent claims 2, 4–9, 13–20, 22, 23, and 25–28. Accordingly, we determine that Petitioner demonstrates by a

preponderance of the evidence that the subject matter of dependent claims 2, 4–9, 13–20, 22, 23, and 25–28 would have been obvious in view of the combined teachings of Wieczorek and Wolf.

5. Conclusion

For the reasons set forth above, Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 1, 2, 4–9, 13–23, and 25–28 would have been obvious in view of the combined teachings of Wieczorek and Wolf.

G. Patentability Challenges Based on Kawagoe and Gupta and Wieczorek, Wolf, and Gupta

Petitioner contends the subject matter of claims 1–9, 13, 14, and 16–28 would have been obvious in view of the combined teachings of Kawagoe and Gupta and the subject matter of claims 1, 2, 4–9, 13–23, and 25–28 would have been obvious in view the combined teachings of Wieczorek, Wolf, and Gupta. *See* Pet. 72–77. Independent claims 1 and 21 each require “transistors” and “devices.” Ex. 1001, 4:61–62, 6:18–19. As explained above addressing the patentability challenge based on Kawagoe alone, Petitioner identifies where Kawagoe teaches the “transistors” and “devices” limitations of claims 1 and 21. *See* Pet. 7–8, 13–17, 28.

Similarly, as explained above addressing the patentability challenge based on Wieczorek and Wolf, Petitioner identifies where Wieczorek teaches the “transistors” and “devices” limitations of claims 1 and 21. *See id.* at 42, 46–55, 58. Petitioner contends that to the extent multiple transistors and devices are required by the limitations of claims 1 and 22, this would have been obvious in view of the teachings of Gupta. *See id.* at 72–77. Patent

Owner does not address the “transistors” and “devices” limitations of independent claims 1 and 21. *See* PO Resp. 11–38.

Based on the complete record developed during trial, including Patent Owner’s evidence of objective indicia of nonobviousness, we find that Petitioner demonstrates by a preponderance of the evidence that the subject matter of claims 1–9, 13, 14, and 16–28 would have been obvious in view of the combined teachings of Kawagoe and Gupta, and that the subject matter of claims 1, 2, 4–9, 13–23, and 25–28 would have been obvious in view of the combined teachings of Wieczorek, Wolf, and Gupta.

*H. Patentability Challenges Based on Kawagoe and Silverbrook
and Wieczorek, Wolf, and Silverbrook*

Petitioner contends the subject matter of dependent claim 19 would have been obvious in view of the combined teachings of Kawagoe and Silverbrook, and the combined teachings of Wieczorek, Wolf, and Silverbrook. *See* Pet. 77–78. Claim 19 depends from claim 1 and recites “the at least one semiconductor device is an image sensor.” Ex. 1001, 5:62–63. Petitioner contends that a person of ordinary skill in the art would have been motivated to implement the CMOS device designs of Kawagoe and Wieczorek-Wolf in an image sensor device as taught by Silverbrook. *See* Pet. 77–78. Patent Owner does not address the limitations of dependent claim 19. *See* PO Resp. 11–38.

Based on the complete record developed during trial, we find that Petitioner demonstrates by a preponderance of the evidence that the subject matter of claim 19 would have been obvious in view of the combined teachings of Kawagoe and Silverbrook and would have been obvious in view of the combined teachings of Wieczorek, Wolf, and Silverbrook.

IV. CONSTITUTIONALITY OF AIA

Patent Owner also contends that “[t]he Board should dismiss this IPR, because the AIA violates the Supreme Court’s non-delegation doctrine and the Constitution.” PO Resp. 62–63. Patent Owner argues the Director improperly has authority to direct whether Patent Owner may receive legal process in the federal courts. *See id.* (“[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 63 (“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.”).

Petitioner persuasively responds:

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[] raise[d] by [Patent Owner] is also logically flawed. According to [Patent Owner], IPRs are unconstitutional because “the 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.” POR, 62-63 (citing *Jarkesy v. Sec. & Exch. Comm’n*, 34 F.4th 446, 461 (5th Cir. 2022)). But these IPRs did not foreclose [Patent Owner] from litigating its patents in an Article III court. [Patent Owner] pushed for an Article III court (the District of Delaware) to evaluate the validity of its patents in parallel to these IPRs. *C.f.* EX1060 (PO Opp. to Mot. to

Stay). The Article III court simply exercised its own discretion and stayed the case.

Pet. Reply 31.

We agree with Petitioner and adopt its foregoing analysis as our own. 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. CONCLUSION

For the foregoing reasons, we determine that Petitioner demonstrates by a preponderance of the evidence that claims 1–9, and 13–28 are unpatentable.²⁶ 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
1–9, 13, 14, 16–28	103(a)	Kawagoe	1–9, 13, 14, 16–28	

²⁶ 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.

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1, 2, 4–9, 13–23, 25–28	103(a)	Wieczorek, Wolf	1, 2, 4–9, 13–23, 25–28	
1–9, 13, 14, 16–28	103(a)	Kawagoe, Gupta	1–9, 13, 14, 16–28	
1, 2, 4–9, 13–23, 25–28	103(a)	Wieczorek, Wolf, Gupta	1, 2, 4–9, 13–23, 25–28	
19	103(a)	Kawagoe, Silverbrook	19	
19	103(a)	Wieczorek, Wolf, Silverbrook	19	
Overall Outcome			1–9, 13–28	

VII. ORDER

For the foregoing reasons, it is:

ORDERED that Petitioner demonstrates by a preponderance of the evidence that claims 1–9 and 13–28 of the ’014 patent are unpatentable;

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

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).

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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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PETITIONER:

Roger Fulghum
Mark Speegle
Daniel Anderson
Ellyar Barazesh
Eliot Williams
Michael Hawes
BAKER BOTTS L.L.P.
roger.fulghum@bakerbotts.com
mark.speegle@bakerbotts.com
daniel.anderson@andersonpatents.com
ellyar.barazesh@bakerbotts.com
eliot.williams@bakerbotts.com
michael.hawes@bakerbotts.com

PATENT OWNER:

Alan Whitehurst
Arvind Jairam
Archis Ozarkar
Scott Hejny
MCKOOL SMITH, P.C.
awhitehurst@mckoolsmith.com
ajairam@mckoolsmith.com
nozarkar@mckoolsmith.com
shejny@mckoolsmith.com