

**PUBLIC VERSION**

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC,  
Petitioner,

v.

GREENTHREAD, LLC,  
Patent Owner.

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IPR2024-00264  
Patent 10,734,481 B2

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

BELISLE, *Administrative Patent Judge*.

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

## I. INTRODUCTION

Semiconductor Components Industries, LLC d/b/a onsemi (“Petitioner” or “onsemi”) filed a Petition (Paper 1, “Pet.”) requesting an *inter partes* review of claims 1–9, 13–27, and 31–36 (“Challenged Claims”) of U.S. Patent No. 10,734,481 B2 (Ex. 1001, “the ’481 patent”), accompanied by the supporting Declaration of Dr. Travis Blalock (Ex. 1003). Greenthread, LLC (“Patent Owner” or “Greenthread”) filed a Preliminary Response. Paper 13 (“Prelim. Resp.”).

With our authorization, Petitioner filed a Preliminary Reply (Paper 15, “Prelim. Reply”), and Patent Owner filed a Preliminary Sur-reply (Paper 18, “Prelim. Sur-reply”).

Upon review of the preliminary record, we instituted *inter partes* review, pursuant to 35 U.S.C. § 314, as to the Challenged Claims based on the challenges set forth in the Petition. Paper 21 (“Institution Decision” or “Inst. Dec.”). Patent Owner filed a Response (Paper 32, “Patent Owner’s Response” or “PO Resp.”); Petitioner filed a Reply to Patent Owner’s Response (Paper 39, “Petitioner’s Reply” or “Pet. Reply”); and Patent Owner filed a Sur-Reply (Paper 44, “Patent Owner’s Sur-Reply” or “PO Sur-Reply”).<sup>1</sup>

On May 6, 2025, we held an oral hearing in this case. A transcript of the hearing is included in the record. Paper 63 (“Tr.”).

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<sup>1</sup> We cite to sealed versions of Patent Owner’s Response (Paper 32), Patent Owner’s Sur-Reply (Paper 44), and Petitioner’s Reply (Paper 39).

For the reasons discussed below, we determine Petitioner has established by a preponderance of the evidence that claims 1–9, 13–27, and 31–36 of the '481 patent are unpatentable.

## II. BACKGROUND

### *A. Real Parties in Interest*

Each party identifies itself as a real party-in-interest. Pet. 1; Paper 4, 2. In addition, Petitioner identifies ON Semiconductor Corporation as a real party in interest. Pet. 1.

In a transcript of a telephonic hearing concerning privity, the parties confirmed that, for Petitioner, the undisputed real parties in interest are Semiconductor Components Industries, LLC, and ON Semiconductor Corporation. Ex. 1064, 7:7–17.

### *B. Related Matters*

The parties indicate that the '481 patent is involved in the following district court cases:

*Greenthread, LLC v. Cirrus Logic, Inc.*, Case No. 1:23-cv-00369 (W.D. Tex.);

*Greenthread, LLC v. OmniVision Technologies, Inc.*, Case No. 2:23-cv-00212 (E.D. Tex.);

*Greenthread, LLC v. OSRAM GmbH et al.*, Case No. 2:23-cv-00179 (E.D. Tex.);

*Greenthread, LLC v Texas Instruments Incorporated*, Case No. 2:23-cv-00157 (E.D. Tex.); and

*Greenthread, LLC v. Monolithic Power Systems, Inc.*, Case No. 1:23-cv-00579 (D. Del.). Pet. 1; Paper 4, 2–3.

The parties also indicate that the '481 patent was previously involved in the following district court cases:

*Greenthread, LLC v. Intel Corp., Dell Inc., and Dell Technologies Inc.*, Case No. 6:22-cv-00105 (W.D. Tex.), a portion of which was transferred to *Greenthread, LLC v. Intel Corp.*, 3-22-cv-02001 (D. Or.);

*Greenthread, LLC v. Micron Technology, Inc. et al.*, Case No. 1:23-cv-00333 (D. Del.); and

*Greenthread, LLC v. Western Digital Corp. et al.*, Case No. 1:23-cv-00326 (D. Del.).

Pet. 2; Paper 4, 5.

The parties also indicate that the '481 patent is/was the subject of the following administrative proceedings:

*Cirrus Logic, Inc. et al. v. Greenthread, LLC*, IPR2024-00001 (filed Oct. 12, 2023);

*Intel Corp. v. Greenthread, LLC*, IPR2023-00260 (filed November 28, 2022);

*Sony Group Corp. v. Greenthread, LLC*, IPR2023-00375, (filed December 17, 2022); and

*Dell Technologies Inc. et al v. Greenthread, LLC*, IPR2023-00507, (filed January 27, 2023). Pet. 2; Paper 4, 3, 5–6.

*C. The '481 Patent*

The '481 patent, titled “Semiconductor Devices with Graded Dopant Regions,” issued on August 4, 2020. Ex. 1001, codes (45), (54).<sup>2</sup> The '481 patent “relates to all semiconductor devices and systems.” *Id.* at 1:36–37. According to the '481 patent, in bipolar junction transistors, “[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.” *Id.* at 1:59–61. This improvement has not been implemented in “most semiconductor devices, including various power MOSFETs . . . [and] IGBT[s],” which “still use a uniformly doped ‘drift epitaxial’ region in the base.” *Id.* at 1:61–66. The invention of the '481 patent implements graded dopant concentration in these devices, which causes “[t]wo important performance enhancements.” *Id.* at 3:42–43. These include sweeping electrons “from source to drain rapidly” and simultaneously causing holes to “be recombined closer to the n+ buffer layer,” which “can improve  $t_{ON}$  and  $t_{OFF}$  in the same device.” *Id.* at 3:43–47.

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<sup>2</sup> The '481 patent issued from application No. 16/717,950, filed on Dec. 17, 2019, is a continuation of application No. 15/590,282, filed on May 9, 2017, now U.S. Patent No. 10,510,842, which is a continuation of application No. 14/931,636, filed on Nov. 3, 2015, now U.S. Patent No. 9,647,070, which is a continuation of application No. 14/515,584, filed on Oct. 16, 2014, now U.S. Patent No. 9,190,502, which is a continuation of application No. 13/854,319, filed on Apr. 1, 2013, now abandoned, which is a continuation of application No. 11/622,496, filed on Jan. 12, 2007, now U.S. Patent No. 8,421,195 (“the '195 patent), which is a division of application No. 10/934,915, filed on Sep. 3, 2004, now abandoned. Ex. 1001, codes (21), (22), (60).

*D. Illustrative Claim*

Of the Challenged Claims, claims 1 and 20 are independent. Claim 1 is illustrative and reproduced below.

1. A semiconductor device, comprising:
  - [1.1] a substrate of a first doping type at a first doping level having first and second surfaces;
  - [1.2] a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
  - [1.3] a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
  - [1.4] transistors formed in at least one of the first active region or second active region;
  - [1.5] 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 surface to the second surface of the substrate; and
  - [1.6] 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 first surface to the second surface of the substrate.

Ex. 1001, 4:50–5:3 (bracketed designations added by Petitioner (*see* Pet. 7–24, App. A, 1)).

*E. Asserted Challenges to Patentability*

Petitioner asserts that claims 1–9, 13–27, and 31–36 are unpatentable based on the following challenges:

<b>Claim(s) Challenged</b>	<b>35 U.S.C. §</b>	<b>Reference(s)/Basis</b>
1–9, 13, 14, 16–27, 31–36	103(a) <sup>3</sup>	Kawagoe <sup>4</sup>
1, 2, 4–9, 13–22, 24–27, 31–36	103(a)	Wieczorek <sup>5</sup> , Wolf <sup>6</sup>
1–9, 13, 14, 16–27, 31–36	103(a)	Kawagoe, Gupta <sup>7</sup>
1, 2, 4–9, 13–22, 24–27, 31–36	103(a)	Wieczorek, Wolf, Gupta
19, 36	103(a)	Kawagoe, Silverbrook <sup>8</sup>
19, 36	103(a)	Wieczorek, Wolf, Silverbrook

<sup>3</sup> The Leahy-Smith America Invents Act, Pub. L. No. 112–29, 125 Stat. 284 (2011) (“AIA”), included revisions to 35 U.S.C. §§ 102 and 103 that became effective after the effective filing date of the challenged claims. *See* Ex. 1001, codes (22), (60). Therefore, we apply the pre-AIA versions of 35 U.S.C. §§ 102 and 103(a).

<sup>4</sup> U.S. Patent No. 6,043,114, filed September 22, 1997, issued March 28, 2000, to Kawagoe et al. (Ex. 1007, “Kawagoe”).

<sup>5</sup> U.S. Patent Application Pub. No. 2003/0183856 A1, filed October 29, 2002, published October 2, 2003, to Wieczorek et al. (Ex. 1006, “Wieczorek”).

<sup>6</sup> Petitioner cites four volumes for Wolf: STANLEY WOLF & RICHARD TAUBER, SILICON PROCESSING FOR THE VLSI ERA, VOLUME 1 – PROCESS TECHNOLOGY, 2nd ed., (Lattice Press 2000) (Ex. 1008A); STANLEY WOLF & RICHARD TAUBER, SILICON PROCESSING FOR THE VLSI ERA, VOLUME 2 – PROCESS INTEGRATION, (Lattice Press 2000) (Ex. 1008B); STANLEY WOLF & RICHARD TAUBER, SILICON PROCESSING FOR THE VLSI ERA, VOLUME 3 – THE SUBMICRON MOSFET, (Lattice Press 2000) (Ex. 1008C); and STANLEY WOLF & RICHARD TAUBER, SILICON PROCESSING FOR THE VLSI ERA, VOLUME 4 – DEEP-SUBMICRON PROCESS TECHNOLOGY, (Lattice Press 2000) (Ex. 1008D).

<sup>7</sup> U.S. Patent No. 6,163,877, filed November 5, 1996, issued December 19, 2000, to Gupta (Ex. 1014, “Gupta”).

<sup>8</sup> U.S. Patent No. 6,614,560 B1, filed July 10, 1998, issued September 2, 2003, to Silverbrook (Ex. 1042, “Silverbrook”).

Pet. 6. Petitioner relies on the Declaration of Dr. Travis Blalock (Ex. 1003). Patent Owner relies on the Declaration of Dr. Alexander Glew (Ex. 2064).

### III. PRIVACY – TIMELINESS OF PETITION UNDER 35 U.S.C. § 315(b)

Patent Owner argues that the Petition (and thus this proceeding) should be dismissed because it is untimely. *See, e.g.*, PO Resp. 42–62. In particular, Patent Owner argues Petitioner is *in privity* with Intel Corp. (“Intel”) or ██████████<sup>9</sup> (collectively “Licensees”), who Patent Owner asserts are time-barred under 35 U.S.C. § 315(b) and licensed under the ’481 patent. *Id.* at 48–49.

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” (emphasis added). 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.

Prior to institution, Patent Owner’s arguments regarding privity were based on several theories, including that Petitioner and Licensees “are ‘preceding and succeeding owners of’ the licensed and/or infringing

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<sup>9</sup> Patent Owner argues that “██████ was an RPI [(i.e., real party in interest)] to the First Amended Complaint against ████████,” and “Intel and ████████ were served with a complaint alleging infringement of the Challenged Patent on February 1, 2022.” PO Resp. 49.

products,” that Petitioner makes and supplies accused goods to Licensees, that Petitioner is a beneficiary of the Licensee’s agreements related to accused products, that Petitioner’s licensed sales encumber otherwise infringing articles, that Petitioner apparently indemnifies 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. 29–37.

In the Institution Decision, the Board determined that Patent Owner had not provided a sufficient factual basis upon which to question Petitioner’s representation that it is not time barred, or to show that Petitioner and Intel or █████ were, in fact, privies, based on any of its theories regarding privity. Inst. Dec. 10–16. We incorporate that analysis here, and reconsider Patent Owner’s contention to the extent it is warranted by subsequent, post-hearing argument and evidence. *Id.* at 10–16; *see 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 written decision] is ‘still fair[ly] characterize[ed] as part of the decision to institute.’”) (citations omitted).

Subsequent to the Institution Decision, Patent Owner asserts that (1) control of prior litigation is not required to establish privity (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 Intel or █████, Petitioner has not attempted to carry its burden (*id.* at 50–53); (3) evidence of record shows that the petition is time-barred (*id.* at 53–59); and (4) a finding in Petitioner’s favor would violate Patent Owner’s

constitutional right to due process (*id.* at 59–62). We address these arguments below.

Patent Owner’s argument (4) regarding violation of its constitutional right to due process is based on alleged 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. 61–62 (citing *Goldberg v. Kelly*, 397 U.S. 254, 269 (1970); *Greene v. McElroy*, 360 U.S. 474, 496 (1959); Paper 22, 5, 10). Since Patent Owner’s Response, we have allowed and ordered additional discovery concerning privity, as discussed 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 states:

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 party 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 party 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 the consolidated final hearing 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. Nonetheless, in this proceeding (as well as in IPR2024-00263, IPR2024-00265, and IPR2024-00266), we *sua sponte* issued a Discovery Order (Paper 62, “Disc. Order”), “narrowly tailored,” consistent with the Director Review Order, ordering Petitioner to provide the following discovery to Patent Owner:

- (a) [D]ocuments [including]:
- [i. s]ales agreements between Petitioner and Intel for the Intel Accused Products;<sup>10</sup> and
  - [ii. i]ndemnification agreements between Petitioner and Intel for the Intel Accused Products. *See* IPR[2024-0]1242, [Dir. Rev. Order] 3; IPR[2024-0]1242, Paper 108 at 11 (indicating Petitioner’s ability and willingness to produce such discovery in the first wave cases).
- (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” (IPR[2024-0]1242, Paper 108 at 12), 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.

In response to our Discovery Order, Petitioner produced and Patent Owner filed the Second Declaration of Matthew Murphy (Ex. 2914, “Second Murphy Declaration”). Patent Owner cross-examined Mr. Murphy and filed a deposition transcript for Mr. Murphy (Ex. 2915).<sup>11</sup> Patent Owner subsequently filed a Patent Owner’s Post-Hearing Brief Concerning Board-Ordered Discovery (Paper 67, “PO Privity Resp.”), Petitioner filed

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<sup>10</sup> The “products accused” consist of “the ‘Intel Accused Products’” identified on pages 4–8 of Exhibit 2048, namely, the Intel “products accused of practicing the challenged claims” in Patent Owner’s prior litigation.

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

Petitioner’s Responsive Post-Hearing Brief (Paper 70, “Pet. Privity Reply”), and Patent Owner filed Patent Owner’s Reply Post-Hearing Brief Concerning Board-Ordered Discovery (Paper 71, “PO Privity Sur-Reply”). We conducted a telephonic hearing on September 18, 2025 (Ex. 1064, “Privity Tr.”).

We note that 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 Resp. 1–2; PO Privity Sur-Reply 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).

Based on the complete record before us, we determine that Petitioner is not in privity with Intel<sup>12</sup>, and the Petition is not time-barred under 35 U.S.C. § 315(b). We turn first to a review of § 315(b) and privity, followed by the parties’ arguments and evidence and our analysis thereof.

*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

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<sup>12</sup> We address [REDACTED] (and [REDACTED]) below in Section III.E.7.

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 Consolidated Trial Practice Guide (“Practice Guide” or “CTPG”) <sup>13</sup> at I.D.1.

Like the common-law preclusion doctrines, the preclusive effect of § 315(b) also extends beyond those who were parties to the prior lawsuit. Because nonparty preclusion risks binding those who have not had a full and fair opportunity to litigate, the Supreme Court has cautioned that there is a general rule against nonparty preclusion, subject only to limited exceptions. See *Taylor v. Sturgell*, 553 U.S. 880, 892–93 (2008). In *Taylor*, while noting that it was not a “definitive taxonomy” (*id.* at 893 n.6), the Court set forth a list of six “categories” under which nonparty preclusion may apply. <sup>14</sup>

(1) “[A] person who *agrees to be bound* by the determination of issues in an action between others is bound in accordance with the terms of his agreement.” *Id.* at 893.

(2) “[N]onparty preclusion may be justified based on a variety of *pre-existing substantive legal relationships* 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.

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<sup>13</sup> Available at [www.uspto.gov/patents/ptab/trial-practice-guide](http://www.uspto.gov/patents/ptab/trial-practice-guide).

<sup>14</sup> For clarity, we omit internal quotation marks and citations throughout the list of categories enumerated in *Taylor*, and add emphasis on certain key phrases, and generally cleaned up the quotations.

(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 was 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.

(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.

(5) “[A] party bound by a judgment may not avoid its preclusive force by *relitigating through a proxy*,” such as “when a nonparty later brings suit as an agent for a party who is bound by a judgment.” *Id.*

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

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

#### B. *Privity Law*

“[T]he mere existence of some relationship between a petitioner and another entity is not sufficient” to place that petitioner in privity with that entity. *Google LLC v. DDC Technology, LLC*, IPR2023-00707, Paper 27 at 37 (PTAB Oct. 25, 2023). Instead, “that relationship must be related to

[an earlier] lawsuit and be sufficiently close that it can be fairly said *the petitioner had a full and fair opportunity to litigate the validity of the patent in that lawsuit.*” *Id.* (emphasis added). In other words, privity concerns “whether the petitioner and the prior litigant’s relationship—as it relates to the [earlier] lawsuit—is sufficiently close that it can be fairly said that the petitioner had a full and fair opportunity to litigate the validity of the patent in that lawsuit,” or “whether the petitioner is simply serving as a proxy to allow another party to litigate the patent validity question that the other party raised in an earlier filed litigation.” *WesternGeco LLC v. ION Geophysical Corp.*, 889 F.3d 1308, 1319 (Fed. Cir. 2018).

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

Courts examine different aspects of the parties’ relationship, depending on the issue for which privity is being asserted. *See Int’l Nutrition Co. v. Horphag Research, Ltd.*, 220 F.3d 1325, 1329 (Fed. Cir. 2000) (“[a] variety of relationships between two parties can give rise to the conclusion that a nonparty to an action is ‘in privity’ with a party to the action”). For example, the parties’ contractual relationship (privity of

contract) regarding a product is relevant when determining whether an injunction against the sale of that product applies. *See In re Cyclobenzaprine Hydrochlorine 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.

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 must 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 the petitioner has “enjoyed its day in court” through its relationship with the litigant, it is fair to consider the parties to be privies. In *Taylor*, the Court held:

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

*Taylor*, 553 U.S. at 895.

*C. Petitioner’s Privity 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. Privity Reply 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.

*D. Patent Owner’s Privity Arguments*

Patent Owner argues that it “has presented far more than ‘some evidence’ that time-barred parties, including Intel, should have been named as [an] RPI in the Petition.” PO Privity Resp. 2 (footnote omitted). Patent Owner also argues that it “maintains that Petitioner is in privity with both [REDACTED], two other time-barred parties” and “that discovery should have been granted as to these parties for at least the reasons presented in

PO’s portion of the Joint Paper Concerning Additional Discovery.” *Id.* at 2 n.3 (citing IPR2023-01242, Paper 108, 2–5).

Based on those allegations, Patent Owner takes issue with Petitioner’s Second 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 Resp. 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 Resp. 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.

*E. Analysis of the Parties’ Privity Arguments*

*1. Overview*

Our analysis below concerns whether Petitioner is in privity with Intel. *See* Dir. Rev. Order 2–3. *Worlds* is a seminal case that addresses

burdens on the parties when § 315 is at issue. 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.” *Worlds*, 903 F.3d 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.* “[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 the present proceeding, contrary to its repeated protestations (*see, e.g.*, Papers 67, 71), 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 we were to agree that Patent Owner produced sufficient evidence to put the relationship between Petitioner and Intel into dispute, the evidence adduced during trial and on remand sufficiently supports Petitioner’s contention and, in particular, satisfies Petitioner’s burden to show it is not time barred under § 315(b), as discussed below.

The evidence adduced during trial and post-hearing discovery, briefing, and supplemental telephonic hearing does not support a finding that the relationship between Petitioner and Intel is sufficiently close such 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. 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. Privity Reply 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 IPRs<sup>15</sup>, we next consider Petitioner and Intel’s relationship, as it relates to the Intel litigation. We consider whether that relationship is sufficiently close such that the Intel litigation would have given Petitioner a full and fair opportunity to litigate the validity of the challenged claims of the ’481 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*,

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<sup>15</sup> Patent Owner does not argue that Intel is an RPI to the present *inter partes* review proceeding and there is no evidence in the record to support this.

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 privity so as to put the issue into dispute. *See* Dir. Rev. Order 3. It is worth emphasizing here that, contrary to Patent Owner’s position (*see, e.g.*, PO Privity Resp. 2), the Director did not indicate that Patent Owner had met its burden of production under the *Worlds* decision. 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 privity *so as to have put the issue into dispute.*” Dir. Rev. Order 3 (emphasis added).

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.

Privity Reply 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. Privity Reply 13; *but see* PO Privity Resp. 14–15.

We 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 Resp. 9–13. The Declaration produced by Petitioner is sufficient to comply with our 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. Privity Reply 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 answer is no.

## 2. *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 Privity Sur-Reply 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 Privity Sur-Reply § II.B); PO Privity Resp. 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. Privity Reply 7 (emphasis added) (citing Ex. 2914 ¶ 7; Ex. 2915, 26:9–13 (“None of the parts [onsemi] sell[s] would be part of a[n] Intel CPU.”), 33:20–34:8, 35:14–19, 36:15–17, 83:6–12).

3. *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 Resp. 2–3 (citing Ex. 2009, 2 (listing Intel as a “[t]op OEM customer”); Ex. 2915, 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. Privity Reply 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)).

According to Patent Owner, “[p]er its ‘Standard Terms and Conditions of Sale’ (T&Cs), Petitioner indemnifies its customers.” PO

Privity Resp. 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. 2915,<sup>16</sup> 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. 2915, 74:15–22). Those arguments are mooted 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. Privity Reply 11 (citing Ex. 2914 ¶¶ 7–8).

#### 4. *Adjacency to 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; Remand 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 infringement derives from the IAPs specifically identified in the list of infringement contentions. *See* Ex. 2048, 3–8.

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<sup>16</sup> Patent Owner cites incorrectly to Exhibit 2104, which does not exist in this case. The cited passages and quoted material come from Exhibit 2915.

5. *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 Resp. 3 (citing Ex. 2053; Ex. 2915, 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. Privity Reply 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*, IPR2022-00615, Paper 64 at 22–26 (same).

6. *Alleged Sub-license from RPX Corporation (“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 Resp. 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 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. Privity Reply 10–11.

7. *Summary*

Based on the complete record before us, including the evidence adduced during trial and post-hearing discovery, briefing, and hearing, we determine Patent Owner did not produce at least “some evidence” to support its argument that Intel should be named as a privy so as to have 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). Even if we were to agree that Patent Owner met its burden of production, we determine that the totality of evidence adduced during trial and post-hearing discovery, briefing, and hearing sufficiently supports Petitioner’s contention and, in particular, satisfies Petitioner’s burden to show it is not time barred under § 315(b).

As for Patent Owner’s argument that it “maintains that Petitioner is in privity with both [REDACTED], two other time-barred parties,” and “that discovery should have been granted as to these parties for at least the reasons presented in PO’s portion of the Joint Paper Concerning Additional Discovery,” we decline to address this argument. PO Privity Resp. 2 n.3 (citing IPR2023-01242, Paper 108, 2–5). The Director Review Order made clear that our earlier Final Written Decisions in related proceedings (i.e., IPR2023-01242, IPR2023-01243, IPR2023-01244) 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. Regardless, [REDACTED] was served with an

infringement complaint on January 23, 2023, 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; rather, [REDACTED] is alleged to be an RPI of an alleged RPI—[REDACTED]—a degree of separation that is not contemplated by the clear language of the statute.

We turn next to Petitioner’s challenges to the patentability of the Challenged Claims. 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.”).

#### IV. PATENTABILITY

##### A. *Applicable Law*

“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) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the

grounds for the challenge to each claim”)) (emphasis added). This burden never shifts to Patent Owner. *See 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 if “the differences between the subject matter sought to be patented 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 skill in the art; and (4) when of record, objective evidence of obviousness or nonobviousness, i.e., secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). Secondary considerations may include the following: “commercial success, long felt but unsolved needs, failure of others, etc.” *Id.* The totality of the evidence submitted may show that the challenged claims would not have been obvious to one of ordinary skill in the art. *In re Piasecki*, 745 F.2d 1468, 1471–72 (Fed. Cir. 1984). When evaluating a combination of teachings, we must also “determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

The Supreme Court has made clear that we apply “an expansive and flexible approach” to the question of obviousness. *KSR*, 550 U.S. at 415. Whether a patent claiming a combination of prior art elements would have been obvious is determined by whether the improvement is more than the

predictable use of prior art elements according to their established functions. *Id.* at 417. To reach this conclusion, however, requires more than a mere showing that the prior art includes separate references covering each separate limitation in a claim under examination. *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011). Rather, obviousness requires the additional showing that a person of ordinary skill at the time of the invention would have selected and combined those prior art elements in the normal course of research and development to yield the claimed invention. *Id.* “To satisfy its burden of proving obviousness, a petitioner cannot employ mere conclusory statements. The petitioner must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

*B. Level of Ordinary Skill in the Art*

In determining 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).

According to Petitioner,

[a] person of ordinary skill in the art (“POSITA”) for the ’481 Patent 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. Additional education might compensate for less experience, and vice-versa.

Pet. 6 (citing Ex. 1003 ¶ 47).

Patent Owner argues 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. Additional education in a relevant field or industry experience may compensate for a deficit in one of the other aspects of the requirements stated above.

PO Resp. 9 (citing Ex. 2064 ¶¶ 17–18).

Petitioner's and Patent Owner's definitions for level of ordinary skill in the art are substantially similar. In light of the record before us, we adopt Petitioner's proposal regarding the level of ordinary skill in the art. Based on our review of the '481 patent and the prior art of record, we determine that the definition offered by Petitioner comports with the qualifications a person would have needed to understand and implement the teachings of the '481 patent and the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that specific findings regarding ordinary skill level are not required “where the prior art itself reflects an appropriate level and a need for testimony is not shown”) (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163 (Fed. Cir. 1985)). Patent Owner does not argue, nor do we determine, that the outcome of our Decision depends on which party's definition is selected.

*C. Claim Construction*

We construe claims “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), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b); *see also Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc).

In this context, claim terms “are generally given their ordinary and customary meaning” as understood by a person of ordinary skill in the art in question at the time of the invention. *Phillips*, 415 F.3d at 1312–13; *see CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002) (There is “a ‘heavy presumption’ that a claim term carries its ordinary and customary meaning.”). “In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). Extrinsic evidence is “less significant than the intrinsic record in determining ‘the legally operative meaning of claim language.’” *Phillips*, 415 F.3d at 1317.

Neither party proposes any claim terms for *express* construction. Pet. 6–7; PO Resp. 9–10 (citing Ex. 2064 ¶¶ 20–25, 48). However, Patent Owner implicitly construes “graded dopant concentration to aid carrier movement” to require carrier movement, and Petitioner disagrees. PO

Resp. 10–21; Pet. Reply 1, 3–19. We address the implicit constructions below in Section IV.E.5 (analysis of Kawagoe challenge).

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 Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”)).

*D. Objective Indicia of Nonobviousness*

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

Patent Owner bears the burden of establishing that a nexus exists between the objective evidence and the claimed invention. *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. *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)).

1. *The Parties’ Arguments*

Patent Owner contends that “[d]uring its prior litigation against [REDACTED], RPX Corp. (‘RPX’) approached Greenthread about negotiating a license on behalf of [REDACTED] and other companies,” and “Greenthread and RPX then negotiated a license for [REDACTED]” PO Resp. 39 (citing Ex. 2078 (Rao Declaration)). Patent Owner contends that it “never threatened litigation against either [REDACTED] [REDACTED] in any way.” *Id.* 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 now having paid more than [REDACTED] for licenses to just one patent family. *Id.* at 41. Patent Owner asserts that licenses taken without threat of litigation are especially probative of nonobviousness. *Id.* at 39 (citing *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1353 (Fed. Cir. 2012)). Patent Owner contends [REDACTED]

are sophisticated companies who frequently file IPR petitions, yet both paid for licenses covering just the single patent family at issue here. *Id.* at 39–40.

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 one license was negotiated through RPX, which structures its arrangements to avoid litigation costs. Pet. Reply 27–28.

Patent Owner argues in its Sur-Reply that “[e]ach license agreement covers a *single patent family* with nearly identical specifications, and the ‘claimed feature of using a graded dopant’ *is* recited in the licenses.” PO Sur-Reply 15 (citing Ex. 2078 ¶¶ 2–3, pp. 19, 45). Patent Owner further argues that “Petitioner’s reliance on RPX’s marketing material is simply out of place, as it can point to zero evidence that [REDACTED] were ‘motivated by avoiding litigation costs.’” *Id.* (quoting Pet. Reply 28).

## 2. *Analysis of the Parties’ Arguments*

We find that there is a nexus between the objective indicia and the challenged claims based on the RPX license that includes Application No. 16/717,950, which issued as the ’481 patent, in the listing of the patent family covered by the license. *See* Ex. 2078, 18–19 (Appendix A, Exhibit B); *Ancora*, 140 F.4th at 1362. Patent Owner relies on the RPX license to [REDACTED] 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’” is “part and parcel” with the RPX license. PO Resp. 40 (quoting Ex. 1001, 3:52–56). We have

considered the RPX license to [REDACTED] and Patent Owner's argument.

Even though Patent Owner has established a nexus between its licensing revenue and the Challenged Claims of the '481 patent, we determine such evidence does not outweigh the strong evidence of obviousness presented by Petitioner. As set forth above, Patent Owner asserts that the innovative and "novel technique" of the patent family is 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). For the reasons discussed below, Petitioner persuasively demonstrates that Kawagoe and Wieczorek disclose such a drift field. Thus, the allegedly novel advancement of the '481 patent is found in the prior art. *See Yita LLC v. MacNeil IP LLC*, 69 F.4th 1356, 1364 (Fed. Cir. 2023) ("But our case law makes clear that objective evidence of nonobviousness lacks a nexus if it exclusively relates to a feature that was known in the prior art—not necessarily well-known." (internal quotations and citations omitted)). Nevertheless, for our analysis and decision in this case, we consider the RPX license to sufficiently support nexus.

Even so, 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] were under no apparent threat of litigation. *See* PO Resp. 5, 39–40. Although Patent Owner argues that the RPX license was not motivated by a threat of litigation, 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] entered a license under no apparent threat of litigation is not persuasive because RPX is a litigation risk mitigation service and, therefore, on this record, the license may reflect the value of avoiding the risk of litigation rather than the value of the challenged patent specifically. *Cf. Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1353 (Fed. Cir. 2012) (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 Elec. Co. Ltd. v. Neonode Smartphone LLC*, IPR2021-00144, Paper 59 at 51 (PTAB Dec. 15, 2022) (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 Electronics* 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 of the contribution that [REDACTED] made towards the lumpsum licensing fee, relative to the contribution of [REDACTED] and/or any other RPX member. The record is not sufficiently developed to determine whether the contribution amounts of [REDACTED] are significant compared to the potential cost of litigation. Ex. 2078 ¶ 6. Indeed, there is

no evidence of record that the average per-company license fee identified by Patent Owner is more (let alone significantly so) than a given company's total external costs (e.g., fees for attorneys, experts, consultants, document review, depositions, and trial) and internal costs (e.g., employee time and business disruption) for multi-year trial and appeal over the Challenged Patents.

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 license is 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 in evaluating Petitioner's obviousness contentions as to 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 grounds based on Kawagoe (a single reference obviousness ground) and 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. Obviousness of Claims 1–9, 13, 14, 16–27, and 31–36 over Kawagoe*

Petitioner contends claims 1–9, 13, 14, 16–27, and 31–36 would have been obvious over Kawagoe. Pet. 7–40; Pet. Reply 1–27. Patent Owner opposes Petitioner’s contentions. PO Resp. 11–39; PO Sur-reply 1–11. For the reasons expressed below, and based on the complete record before us, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 1–9, 13, 14, 16–27, and 31–36 are unpatentable as obvious over Kawagoe. *See Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1361 (Fed. Cir. 2016) (“[A] patent can be obvious in light of a single prior art reference if it would have been obvious to modify that reference to arrive at the patented invention.”); *Therasense, Inc. v. Becton, Dickinson & Co.*, 593 F.3d 1325, 1336–37 (Fed. Cir. 2010) (affirming an invalidity judgment where claims were held obvious over a single reference). We turn first to an overview of Kawagoe.

*1. 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. 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,”<sup>17</sup> as well as “drastically reduc[ing] 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. Ex. 1007, 2:55–3:9. According to Kawagoe, the impurity concentration of the substrate body can be made higher than that of 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. *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. *Id.* at 3:32–38.

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<sup>17</sup> 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 ¶ 76.

Kawagoe describes seven embodiments, including Embodiment 1 (Ex. 1007, 6:41–12:40, Figs. 1–8) and Embodiment 4 (*id.* at 14:46–19:64, Figs. 16–25). According to Embodiment 1, a semiconductor integrated circuit device includes semiconductor substrate body 2S, epitaxial layer 2E, and gettering layer 2G. *Id.* at 6:51–56, Fig. 1. Substrate body 2S and epitaxial layer 2E are doped with 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. *Id.* at 8:46–52, 9:32–40, 11:18–24, 11:43–50, Figs. 1, 5, 7.

According to Embodiment 4, substrate body 2S and epitaxial layer 2E are doped with p-type impurity, and the impurity concentration of substrate body 2S is higher than that of epitaxial layer 2E “to improve the resistance to the latchup.” Ex. 1007, 14:64–15:6, 15:13–17, 16:16–21, 19:59–63, Fig. 17. Embodiment 4 includes p-well 6<sub>p</sub> formed with nMOS 4N and n-well 6<sub>n</sub> formed with pMOS 4P. *Id.* at 15:26–40, 17:40–18:35, Figs. 16, 21–23. In Embodiment 4, the impurity concentration in p-well 6<sub>p</sub> and n-well 6<sub>n</sub> decreases with increasing depth below the epitaxial layer. *Id.* at 15:62–16:15, 17:55–61, Fig. 17. Kawagoe discloses that the concentration gradient reduces soft errors by attracting carriers (electrons) to the substrate and preventing them from entering the p-well. *Id.* at 16:2–11.

Petitioner relies on Kawagoe Figures 17 and 23, which are reproduced below, and which illustrate Embodiment 4 and its properties.

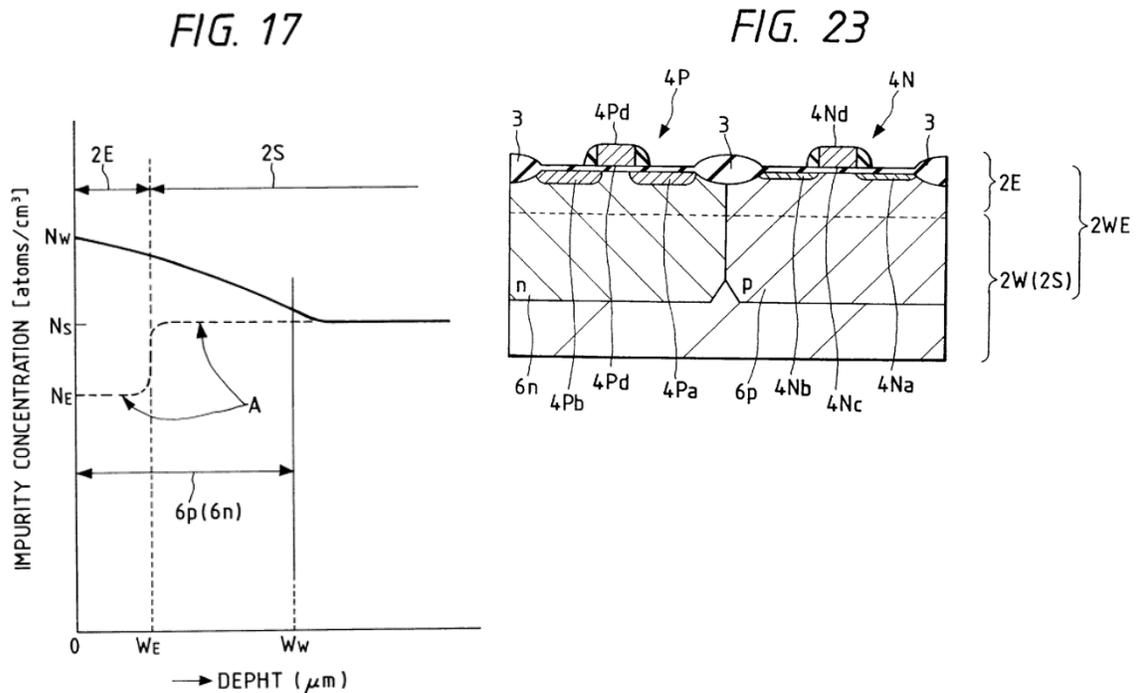


Figure 17 is a plot of impurity concentration as a function of depth in a semiconductor integrated circuit device, which shows “the p-well 6p and n-well 6n have their impurity concentrations gradually lowered in the depthwise direction from the principal surface (having an impurity concentration  $N_w$ ) of the epitaxial layer 2E.” Ex. 1007, 5:41–45, 15:62–16:40. Figure 23 shows a step in a process for manufacturing a semiconductor integrated circuit device, including p-well 6p formed with nMOS 4N and n-well 6n formed with pMOS 4P. *Id.* at 6:1–4, 15:26–32, 18:3–35.

2. *Petitioner’s Contentions for Independent Claim 1*

Petitioner argues that Kawagoe teaches or at least fairly suggests the limitations of claim 1. Pet. 7–29.

*[1.pre] “[a] semiconductor device.”*

The preamble of claim 1 recites “[a] semiconductor device.” Ex. 1001, 4:50. Petitioner contends that “[t]o the extent it is limiting, Kawagoe discloses the preamble[] because Kawagoe is directed to a ‘semiconductor integrated circuit device.’” Pet. 7 (citing Ex. 1007, code (54), 1:13–23, 14:46–67, Figs. 16, 17, 23; Ex. 1003 ¶ 65).

Patent Owner does not contest Petitioner’s evidence pertaining to the preamble of claim 1. Based on the complete record developed during trial, we determine that Petitioner demonstrates by a preponderance of evidence that Kawagoe teaches the subject matter of the preamble of claim 1. As such, we need not and do not determine whether the preamble of claim 1 is limiting.

*[1.1] “a substrate of a first doping type at a first doping level having first and second surfaces.”*

Claim 1 recites “a substrate of a first doping type at a first doping level having first and second surfaces.” Ex. 1001, 4:51–52. Relying on a combination of Kawagoe’s Embodiment 1 and Embodiment 4, Petitioner argues that Kawagoe teaches this limitation. Pet. 8–13. According to Petitioner, “Kawagoe discloses a substrate (‘semiconductor substrate 2’) of a first doping type (p-type) having a silicon ‘epitaxial layer 2E [] doped with a *p-type* impurity such as boron’ formed over non-epitaxial ‘semiconductor substrate body 2S [also] doped with a *p-type* impurity such as boron.” Pet. 8 (citing Ex. 1007, 14:61–15:12, 6:50–7:3). In Petitioner’s annotated version of Kawagoe’s Figure 23 (not reproduced here), “[t]he substrate (orange) has top (‘first surface’) and bottom ([‘]second surface’) surfaces.” *Id.* at 9 (citing Ex. 1003 ¶ 66); *see id.* at 9–13.

Petitioner contends that “Kawagoe teaches an epitaxial substrate (2S+2E), illustrated in Figure 20, in which the non-epitaxial silicon substrate body (2S) is either doped at the same or higher level compared to the epitaxial silicon layer (2E).” Pet. 10. According to Petitioner, “Embodiment 1 describes a uniformly-doped epitaxial substrate in which the ‘epitaxial layer 2E is doped . . . in a concentration *equal* to the [concentration] of the semiconductor substrate body 2S, e.g.,  $1.3 \times 10^{15}$  atoms/cm<sup>3</sup>.” *Id.* (citing Ex. 1007, code (57) 6:60–7:3, 2:57–3:9). Petitioner also contends that “Embodiment 4 introduces an optional latchup-resistant substrate in which ‘the impurity concentration of the semiconductor substrate body 2S is made *higher* than that of the epitaxial layer 2E . . . *to improve* the resistance to latchup.” *Id.* (citing Ex. 1007, 15:13–17; Ex. 1003 ¶¶ 69–70).

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.1]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that the cited portions of Kawagoe, supported by Dr. Blalock’s testimony, teach this limitation of claim 1.

*[1.2] “a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed.”*

Claim 1 recites “a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed.” Ex. 1001, 4:53–56. Petitioner argues that Kawagoe teaches this limitation. Pet. 13–17. Kawagoe discloses “semiconductor regions 4Na and 4Nb . . .

for forming the source-drain regions of the nMOS 4N.” Ex. 1007, 8:66–67, Fig. 23. Petitioner contends that “Kawagoe discloses ‘semiconductor regions 4Na and 4Nb . . . for forming the *source-drain regions* of the nMOS [n-channel transistor] 4N.” Pet. 14 (citing Ex. 1007, 8:66–67, 3:30–37, 8:46–52, 14:46–55, 15:26–40). “Source-drain regions 4Na/4Nb (purple) form part of the claimed first active region, which also includes the channel region (light purple) between source-drain regions 4Na/4Nb and below insulating film 4Nc.” *Id.* (citing Ex. 1007, 8:66–67, 3:30–37, 8:46–65, 14:46–55, 15:26–40; Ex. 1003 ¶ 78; Ex. 1008B, 299–300 (“The top surface of the [substrate] body consists of *active* or *transistor* regions as well as *passive* or (*field*) regions. The *active regions* are those in which transistor action occurs; i.e., the *channel* and the heavily doped *source* and *drain* regions.”), Figs. 5-2, 6-8(c), 6-10; Ex. 1008C, Fig. 8-1(e)) (identified colors included in Petitioner’s annotated version of Figure 23 at page 15 of the Petition).

Petitioner contends that, “[a]s shown in Figure 23 [not reproduced here], nMOS transistor 4N is formed in the surface of the first active region, which is adjacent the first surface of the substrate.” Pet. 14–15 (citing Ex. 1003 ¶ 78). Petitioner further contends that “[s]emiconductor regions 4Na and 4Nb are doped with an *n-type impurity*’ and thus have a second doping type (n-type) opposite in conductivity to the first doping type (p-type) of the substrate.” *Id.* at 15 (citing Ex. 1007, Fig. 23, 8:67–9:3, 14:46–55, 15:26–40; Ex. 1003 ¶ 78). “While Figure 23 illustrates an exemplary nMOS transistor 4N in the first active region, a POSITA would have understood that Kawagoe teaches forming multiple nMOS transistors

in this region to minimize chip area, as good layout practice dictates.” *Id.* (citing Ex. 1003 ¶ 79; Ex. 1014, 1:52–54, 2:17–21); *see id.* at 15–17.

Patent Owner disputes Petitioner’s evidence pertaining to limitation [1.2]. We resolve the dispute about this limitation in our analysis below.

*[1.3] “a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed.”*

Claim 1 recites “a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed.” Ex. 1001, 4:57–59. Petitioner argues that Kawagoe teaches this limitation. Pet. 17–19. Kawagoe discloses “semiconductor regions 4Pa and 4Pb . . . for forming the source-drain regions of the pMOS 4P.” Ex. 1007, 9:47–48, Fig. 23. These regions “are doped with a[] p-type impurity such as boron.” *Id.* at 9:48–50. Petitioner directs us to evidence that source-drain regions 4Pa and 4Pb, as well as the channel region between those regions and below insulating film 4Pc all would have been considered part of an active region. Ex. 1008B, 299–300 (“The active regions are those in which transistor action occurs; i.e., the channel and the heavily doped source and drain regions.”). This active region is separate from and disposed adjacent to the first active region. Ex. 1007, Fig. 23.

Petitioner contends that “Kawagoe discloses ‘semiconductor regions 4Pa and 4Pb . . . for forming the source-drain regions of the pMOS [p-channel transistor] 4P.’” Pet. 17 (citing Ex. 1007, 3:35–37, 8:46–52, 9:41–48, 15:26–40). Petitioner further contends that “[s]ource-drain regions

4Pa/4Pb (green) are part of the claimed second active region, which also includes the channel region (light green) between them and below gate 4Pd.” *Id.* (citing Ex. 1007, 8:46–67, 9:41–46, 14:46–55, 15:26–40; Ex. 1008B, 299–301, Figs. 5-1, 5-2, 6-4; Pet. § VII.A.1.c; Ex. 1003 ¶ 82). According to Petitioner, “[a]s shown in Figure 23, pMOS transistor 4P is formed in the surface of the second active region (green/light green), which is separate from and disposed adjacent to the first active region (purple/light purple).” *Id.* (citing Ex. 1007, 14:46–55; Ex. 1003 ¶ 82). “Adjacent active regions are separated by an isolation region (*e.g.*, insulating film 3).” *Id.* (citing Ex. 1008A, 818–20, Fig. 16-11(f); Ex. 1003 ¶ 83); *see id.* at 18–19.

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.3]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that the cited portions of Kawagoe, supported by Dr. Blalock’s testimony, teach this limitation of claim 1.

*[1.4] “transistors formed in at least one of the first active region or second active region.”*

Claim 1 recites “transistors formed in at least one of the first active region or second active region.” Ex. 1001, 4:60–61. For limitation [1.4], Petitioner relies on its arguments set forth for limitations [1.2] and [1.3]. Pet. 19 (citing Pet. §§ VIII.A.1.c–d; Ex. 1003 ¶ 86).

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.4]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that the cited portions of Kawagoe, supported by Dr. Blalock’s testimony, teach this limitation of claim 1.

[1.5] “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 surface to the second surface of the substrate.”

Claim 1 recites “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 surface to the second surface of the substrate.” Ex. 1001, 4:62–65. Petitioner argues that Kawagoe teaches this limitation. Pet. 19–24. Kawagoe discloses its wells “hav[ing] their impurity concentrations gradually lowered in the depthwise direction from the principal surface . . . of the epitaxial layer 2E.” Ex. 1007, 15:62–16:2, Figs. 17, 23.

Petitioner contends that as illustrated in Figure 23 (reproduced below), “a channel region (light purple) formed at the top surface of the substrate connects source-drain regions 4Na/4Nb (purple) of transistor 4N.” Pet. 19 (citing Ex. 1008B, 298 (“[a] channel region in the semiconductor under the gate electrode separates the source and drain”), 300–301 (“[w]hen positive bias is applied to an NMOS transistor gate . . . an *n*-type **channel** connects the **source** and **drain** regions”), Fig. 5-2; Ex. 1007, 8:60–67, 14:46–55, 15:26–30, 15:37–40; Ex. 1003 ¶ 87).

With respect to Petitioner’s annotated versions of combined Figures 23 and 17 reproduced below, Petitioner further contends that “Kawagoe’s Figure 17 . . . illustrates the doping concentration measured along the red dotted line in Figure 23 . . . which starts from the top surface of the substrate (depth=0) and includes the doping profile in the channel region (light purple).” *Id.* at 20 (citing Figs. 17, 23, 5:41–45).



surface of the epitaxial layer (claimed “first surface”) to the bottom surface of the substrate (claimed “second surface):

[T]he 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  $\alpha$ -ray is lowered. Specifically, the ***electrons produced by the  $\alpha$ -ray are attracted to the substrate body *2S* by that concentration gradient*** ... so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well *6p*.

*Id.* at 22 (citing Ex. 1007, 16:2–11); *see id.* at 23, n.9 (“Kawagoe states that ‘electrons produced by the  $\alpha$ -ray [are] . . . prevented from entering the p-well *6p* . . . .’ This refers to electrons produced in the large substrate body below the wells.”) (citing Ex. 1007, 16:7–9; Ex. 1003 ¶ 91; Ex. 1009, Fig. 2).

Petitioner further contends that “Dr. Blalock explains that during a so-called single event upset (SEU), an  $\alpha$ -ray generates millions of carriers, some of which are produced in or near the active regions at the surface of the substrate.” *Id.* at 23 (citing Ex. 1003 ¶¶ 91–92; Ex. 1009, 431 (“A[n] [ $\alpha$ -]particle can induce SEU when it strikes at the ***channel region*** of an off nMOS transistor.”), Fig. 2). Petitioner also contends that “Kawagoe teaches that those carriers are ‘attracted to the substrate body by [the] concentration gradient’ of the graded dopant concentration illustrated in Figure 17.” *Id.* (citing Ex. 1007, 16:2–11). Petitioner further contends that

Kawagoe’s Figure 17 shows that the dopant concentration is downward-sloping with increasing depth towards/to the bottom of the substrate. . . . Applicant represented to Patent Office during prosecution of the parent ’195 Patent that a downward-sloping graded dopant concentration was known in the prior art to create

an “inherent ‘built-in’ unidirectional electric field” that sweeps carriers down into the substrate, as detailed below in [Petition] §VII.A.1.g.

*Id.* at 23–24 (citing Ex. 1016, 289–290; Ex. 1003 ¶¶ 94–95).

Patent Owner disputes Petitioner’s evidence pertaining to limitation [1.5]. We resolve the dispute about this limitation in our analysis below.

[1.6] “*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 first surface to the second surface of the substrate.*”

Claim 1 recites “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 first surface to the second surface of the substrate.” Ex. 1001, 4:66–5:3. Petitioner argues that Kawagoe teaches this limitation. Pet. 24–29. Kawagoe discloses its wells “hav[ing] their impurity concentrations gradually lowered in the depthwise direction from the principal surface . . . of the epitaxial layer 2E.” Ex. 1007, 15:62–16:2, Figs. 17, 23. Petitioner contends that, as shown in its annotated version of Figure 23, “Kawagoe discloses ‘p-well 6p’ (light green) adjacent to the first active region (purple/light purple).” Pet. 24 (citing Ex. 1007, 8:66–67, 14:46–55, 15:26–40; Ex. 1003 ¶ 96). Petitioner further contends that “as shown in the dopant concentration profile (brown) of Figure 17 . . . the dopant concentration in p-well 6p—measured along the exemplary red dotted line in Figure 23—gradually decreases with depth.” *Id.* (citing Pet. § VII.A.1.f; Ex. 1007, 14:46–55, 15:62–16:40 (“p-well 6p and n-well 6n 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”), 16:11–15). Thus, according to Petitioner, “Kawagoe discloses a well region containing at least one graded dopant region (e.g., the region highlighted in light green in both [Petitioner’s annotated version of] Figures 23 and 17) having a downward-sloping graded dopant concentration.” *Id.* at 25 (citing Ex. 1003 ¶ 97); *see id.* at 26–29.

Patent Owner disputes Petitioner’s evidence pertaining to limitation [1.6]. We resolve the dispute about this limitation in our analysis below.

### 3. *Patent Owner’s Arguments*

Patent Owner disputes Petitioner’s showing with respect to Kawagoe based on five sets of contentions, which we set forth below. *See generally* PO Resp.; PO Sur-Reply. Patent Owner’s first set of contentions relates to limitation [1.2] and the second through fifth sets of contentions relate to limitations [1.5] and [1.6].

a) *Patent Owner’s Contentions that Petitioner’s Challenge does not Teach or Suggest “a first active region . . . with a second doping type opposite in conductivity to the first doping type”*

Patent Owner contends that Kawagoe does not teach or suggest limitation [1.2]. According to Patent Owner, “the Petition mapped ‘a first doping type’ to p-type doping” and asserts that “Kawagoe’s [source-drain] regions 4Na and 4Nb ‘have a second doping type (n-type) opposite in conductivity to the first doping type (p-type) of the substrate.’” PO Resp. 35 (citing Pet. 14). Patent Owner argues that “the Petition also states that the *channel* of transistor 4N is [*also*] part of the first active region.” *Id.* at 36 (alteration added) (citing Ex. 1007, 8:66–9:3; Pet. 24 (“Source-drain regions

4Na/4Nb (purple) form part of the claimed first active region, which also includes the channel region . . . .”). Patent Owner contends that, with respect to limitation [1.5],

which recites “at least a portion of at least one of the first and second active regions having at least one graded dopant concentration . . . .,” the Petition pointed to the concentration profile under the *channel*. But the channel of transistor 4N is doped *p-type*, because it is the top portion of a p-well (as shown in Figure 23 of Kawagoe).

*Id.* at 36 (citing-in-part Pet. 14 (pointing to Kawagoe’s Figure 23, which shows channel of transistor 4N at the top of p-well 6p), 13 (“the channel region (light purple) between source-drain regions 4Na/4Nb”), 19–24).

Patent Owner points to Dr. Glew’s testimony and contends that “the channel of NMOS 4N made from *the p-well, the p-well, and the p type substrate are all doped p-type.*” *Id.* at 36 (citing Ex. 2064 ¶ 34–37) (emphasis added).

*b) Patent Owner’s Contentions that Petitioner’s Challenge does not Calculate Magnitude of Slope of Graded Dopant Concentration*

Patent Owner contends that Petitioner’s challenge is based on inherency and that, as such, “[t]he ‘probability or possibility’ that a dopant gradient aids carrier movement ‘is insufficient.’” PO Resp. 3 (citing *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999)). According to Patent Owner, “[t]he prior art ‘must *necessarily* include the unstated limitation.’” *Id.* (quoting *Transclean Corp. v. Bridgewood Servs., Inc.*, 290 F.3d 1364, 1373 (Fed. Cir. 2002)); *see id.* at 18 (citing *Phillips*, 415 F.3d at 1314). Patent Owner contends that “Petitioner’s references do not teach the ‘aid carrier movement’ claim limitation” and that, “[t]herefore, to locate ‘aid

carrier movement’ in the prior art, [Petitioner] assumes that *any* ‘graded dopant concentration’ will ‘aid carrier movement.’” *Id.* at 11.

Patent Owner contends that “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.” PO Resp. 14; *see id.* at 15 (citing Ex. 2072, 2:66–3:15; quoting Ex. 1001, 3:5–6 (“The gradient can be linear, quasi linear, exponential or complimentary error function.”)).

With regard to related litigations, Patent Owner contends that “[n]ot one but two District Courts have previously agreed with Greenthread that not *all* doping gradients aid carrier movement.” PO Resp. 18. According to Patent Owner, “[t]he Western District of Texas<sup>[18]</sup> 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). “And the Eastern District of Texas<sup>[19]</sup> 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)).

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<sup>18</sup> Exhibit 2080, “WDTX Order”

<sup>19</sup> Exhibit 2082, “EDTX Order”

c) *Patent Owner's Contentions that Petitioner's Challenge does not Account for Additional Forces Acting on a Carrier*

Patent Owner contends that “Petitioner’s assumption that the gradients in their prior art references would aid carrier movement fails, because the Petition fails to analyze whether the specific gradients at issue in the context of the disclosed devices would suffice to overcome the other forces that are present.” PO Resp. 16–17. Patent Owner argues that “if the forces acting on a carrier—i.e. the force exerted by a gradient and *any other forces*—cancel each other out, the carriers do not move at all.” *Id.* at 18 (emphasis added).

Patent Owner also argues that,

during prosecution, the examiner likewise said that in “a complex electronic device, movement of minority carriers is affected by multiple forces and fields” and that a “drift field may attempt to apply a force on all minority carriers in a specific direction” but that “without knowing other parameters of the device” one cannot say whether the field would aid carrier movement. This is exactly what Petitioner’s expert, Cirrus Logic’s 30(b)(6) witness, and Greenthread’s expert testified.

*Id.* at 16 (citing Ex. 1002, 270; Ex. 2064 ¶¶ 52–54, 90, 97, 101).

Patent Owner contends that it

showed Cirrus Logic’s corporate representative, Scott Warrick, a doping profile from one of the Cirrus Logic accused products and asked him if the downward sloping gradient met the “aid carrier movement” claim limitation. He said “**I cannot tell you that.**” Greenthread then asked “**is that because there’s other things that might affect carrier movement besides the gradient?**” to which Mr. Warrick replied “Yes.”

PO Resp. 15–16 (citing Ex. 2083, 95:2–5; 96:1–13); *see id.* at 4 (citing Ex. 2083, 72:6–8, 95:2–5, 96:1–13).

Patent Owner argues that

In its Reply, Petitioner relies upon a new and nonsensical claim construction that “aid carrier movement” does not mean the carriers actually have to move. To use an analogy, this is like arguing that a person can “aid movement” by pushing on a parked car. But a person cannot aid movement of the car, unless the car actually moves. Even Petitioner’s own expert understood “aiding carrier movement” to refer to “sweeping carriers from the active circuitry at the surface into the substrate.” “Sweeping” the carriers means “moving” the carriers, and to argue otherwise is contrary to the surrounding claim language.

PO Sur-Reply 5 (citing Pet. Reply 3; Ex. 1003 ¶ 43).

*d) Patent Owner’s Contentions that Kawagoe Teaches Inhibiting, not Aiding, Carrier Movement*

Patent Owner takes issue with Petitioner’s truncating of a quotation from Kawagoe and, based on the complete quote from Kawagoe, contends that Kawagoe “teach[es] that the graded concentration actually *inhibits* carrier movement.” PO Resp. 25. Specifically, Patent Owner contends that

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

*Id.* at 26 (quoting Ex. 1007, 16:7–11) (emphasis and highlight added by Patent Owner). Instead, Patent Owner argues that

Dr. Blalock admitted that, according to Kawagoe, SEUs<sup>[20]</sup> generate “electrons produced in the large substrate body below the wells”—far below the active regions. Kawagoe’s electrons are *below* p-well 6p, and prevented from moving *upward* into

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<sup>20</sup> “SEU” refers to a “single event upset.” PO Resp. 17 (citing Ex. 1007, 16:7–11).

p-well 6p. Kawagoe's 6p extends to the very top of the device. Therefore, carriers travelling vertically could only enter 6p from below.

*Id.* at 24 (citing Ex. 1003 ¶ 94 n.6; Ex. 2064 ¶¶ 56–57).

e) *Patent Owner's Contentions About the Cited Underlying Evidence and Whether There are Carriers in Kawagoe's Active Region*

Patent Owner contends that “Kawagoe doesn't teach anything about carriers in the “active region” and “the Petition relies on testimony from Dr. Blalock and another reference [Wang (Ex. 1009)] to fill the gap” with respect to Kawagoe. PO Resp. 27. Patent Owner contends that Petitioner has not established public availability of Wang, “which purports to be from 2008, i.e., four years after the critical date of the Challenged Patent.” *Id.* at 27–28 (citing Ex. 1003 ¶ 95; Pet. ix; Ex. 1009, 429 (listing Wang's copyright date as 2008)) (emphasis omitted).

Patent Owner also contends that

[a]s explained by Dr. Glew—who has experience working with alpha rays/alpha particles—a POSITA would have understood when Kawagoe mentions “electrons produced by the  $\alpha$ -ray”, Kawagoe is *not* describing electrons near the surface. Dr. Glew cites Nishizawa<sup>[21]</sup>—a reference from *before* the Challenged Patent's priority date—to demonstrate what a POSITA would have known:

Accordingly, it will be understood that the alpha-particle immediately after irradiation to the surface of a semiconductor body has an energy of several MeV, for example about 5 MeV, and that, accordingly, ***the probability of creation of electron-hole pairs is extremely low near the surface.*** The alpha-particle will begin to

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<sup>21</sup> U.S. Patent No. 5,384,476 issued January 24, 1995 to Nishizawa et al. (Ex. 2066, “Nishizawa”).

create electron-hole pairs after it has entered into the semiconductor substrate to a certain distance.

PO Resp. 28–29 (quoting Ex. 2066, 19:21–34) (citing Ex. 2066, 20:19–22 (“[T]he amount of electrons created which adversely affect the memory action is no greater than only 10% of the stored electric charge, and thus it can be disregarded.”); Ex. 2064 ¶¶ 10, 51–57, 66, 67; Ex. 1007, 16:7–11).

Patent Owner further contends that “[t]hus, a POSITA would have understood that Kawagoe’s electrons that are prevented from entering the p-well are *not* created near the surface.” PO Resp. 29–30. Patent Owner takes the position that “Kawagoe does not address carriers in the ‘active region’ and does not ‘aid carrier movement *from the [first and second active regions | first or second active region | surface]*’ because Kawagoe’s carriers are nowhere near what Petitioner identifies as the ‘surface’ or first/second ‘active regions’ and are in fact ‘prevented from entering the p-well 6p’ which stands between them and the ‘active regions.’” *Id.* at 24–25.

#### 4. *Petitioner’s Reply Arguments*

Petitioner responds to Patent Owner’s arguments. *See generally* Pet. Reply.

a) *Petitioner’s Reply to Patent Owner’s Contentions that Petitioner’s Challenge does not Teach or Suggest “a first active region . . . with a second doping type opposite in conductivity to the first doping type”*

In response to Patent Owner’s *first* set of arguments, Petitioner contends that Patent Owner’s “argument is based on an unsupported narrow interpretation of this claim language, which the Board correctly rejected in the Parallel IPRs.” Pet. Reply 22 (citing IPR2023-01243, Paper 82, 26–27).

In particular, Petitioner argues “Kawagoe has a first active region with a doping type opposite to the substrate because the first active region identified in Figure 23 of Kawagoe has n-type doped source and drain regions, which are opposite to a p-type substrate.” Pet. Reply 22 (citing Pet. 13–17, 46–49; Ex. 1056, 136:15–137:14). Petitioner adds that Patent Owner concedes this: “This feature in Kawagoe is consistent with Figures 5B and 5C of the ’481 Patent, which [Patent Owner] and Dr. Glew say ‘clearly disclose[]’ the ‘claimed invention.’” *Id.* at 22–23 (citing PO Resp. 6; Ex. 2064 ¶ 34).

Alternatively, Petitioner argues that, “even under the [Patent Owner’s] incorrect interpretation, Kawagoe still teaches this limitation.” Pet. Reply 24. Specifically, according to Petitioner, “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.” *Id.* (citing Ex. 1007, 9:40–54, 17:50–54, 18:15–23, 21:55–61, Fig. 23). Petitioner submits that “Dr. Glew agreed that a p-type transistor having an n-type channel (“PNP”) would be opposite to a p-type substrate.” *Id.* at 25 (citing Ex. 1056, 73:6–13, 22:7–28:24, 71:12–75:23, 132:24–137:14).

b) *Petitioner’s Reply to Patent Owner’s Contentions that Petitioner’s Challenge does not Calculate Magnitude of Slope of Graded Dopant Concentration*

With respect to Patent Owner’s *second* set of contentions, Petitioner contends that “[t]he challenged claims are apparatus claims—not method claims” and as such, “the ‘to aid carrier movement’ terms should be understood to ‘cover what a device *is*, not what a device *does*.” Pet. Reply 3

(citing *ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018)); *see id.* (“[A]iding movement is different from *creating* movement. Nothing in the claims requires the graded dopant concentration to create movement where none exists.”). According to Petitioner, “Kawagoe’s graded dopant concentration ‘is capable of performing the claimed limitation,’” and “[Patent Owner’s] expert, Dr. Glew, admitted that starting at the surface of the device (i.e., throughout the active region), Kawagoe’s graded dopant concentration produces an electric field that pushes electrons (carriers) downward from the surface to the substrate.” *Id.* at 2 (citing Ex. 1056, 113:4–114:10). Petitioner argues that Patent Owner conceded, “[o]f course Kawagoe’s transistor, like any transistor, will have carriers in the active region,” and that such admissions “demonstrate that Kawagoe’s graded dopant concentration would aid the movement of carriers as claimed.” *Id.* (citing Paper 18 (PO’s Preliminary Sur-Reply), 6; Ex. 1001, 4:62–5:3).

Petitioner contends that, during prosecution of related U.S. Patent No. 8,421,195, Patent Owner “contradicted the arguments it makes here” concerning slope of graded dopant concentration. Pet. Reply 4–5. Specifically, Petitioner responds that Patent Owner previously represented to the Office that “a downward-sloping graded dopant concentration was known to create an ‘inherent “built-in” unidirectional electric field’ that sweeps carriers down into the substrate,” but now, “wrongly tries to twist this plain statement by arguing that the movement of carriers ‘[d]epend[s] on the particular slope of the graded concentration of dopant[s].’” *Id.* at 4 (citing Ex. 1016, 289–290; PO Resp. 12, 21). “[W]hen read in context, the use of ‘particular slope’ in the prosecution history relates to whether the

slope is positive or negative and thereby creates an electric field that sweeps all carriers ‘up’ or ‘down.’” *Id.* In ongoing prosecution of a related patent application (U.S. 17/728,588), Petitioner notes that Patent Owner again argued to the Examiner that “‘relative slope’ [] means nothing more than the fact that one-side is relatively lower than the other side.” *Id.* at 4–5 (citing Ex. 1058, 12; Ex. 1059, 5). Petitioner submits that Patent Owner’s statements during prosecution of multiple related applications “demonstrate that no specific magnitude or absolute value of slope is required, and no actual movement is needed.” *Id.*

With regard to related litigations, Petitioner argues that, contrary to Patent Owners protestations, “no district court has ever ‘said that ‘the graded concentration has to be sufficiently graded’ to cause movement.’” Pet. Reply 5. Regarding the WDTX case, Petitioner argues:

The “sufficiently graded” language that [Patent Owner] borrows comes from the WDTX’s analysis of an indefiniteness argument for the “graded dopant concentration” terms. EX2080, 39-40. Defendants in the WDTX case argued that “graded dopant concentration” was indefinite because it was unclear when a given concentration became “graded” for purposes of the claim. *Id.*, 32-35. The WDTX court disagreed, holding that “graded dopant concentration” was not indefinite because “the graded concentration has to be sufficiently graded to result in a ‘static unidirectional electric drift field to aid the movement of minority carriers.’” *Id.* Nothing in the court’s holding suggests “to aid the movement” means “to cause movement.”

*Id.* Petitioner argues that Patent Owner’s briefing to the WDTX court “further confirms that any non-zero magnitude is sufficient for the ‘to aid carrier movement’ limitation,” especially because Patent Owner “told the WDTX court that the only requirement for a graded dopant concentration to

‘aid[] the movement of minority carriers’ is being non-uniform” *Id.* at 6. (citing Ex. 1061, 17–18). Indeed, Patent Owner further emphasized the simplicity of this assessment: “Anyone that has taken high school math knows that ‘slope’ measures how much the line changes. 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).” *Id.* (citing Ex. 1061, 18). Petitioner submits that these arguments “directly contradict [Patent Owner’s] assertion in these IPRs that Dr. Blalock needed to measure the magnitude gradient slopes to determine whether the prior art would ‘aid carrier movement.’” *Id.* (citing PO Resp. 23).

Regarding the EDTX case, Petitioner argues:

[T]he Eastern District of Texas did not construe the “to aid carrier movement” language. The section of the EDTX claim construction order that [Patent Owner] cites addresses whether the dopant concentration must be only increasing or only decreasing. EX2082, 13-15. When evaluating this issue, the EDTX court accepted from the prosecution history “that the direction of the electrical field and the carrier movement ‘depends solely on the slope of the graded concentration of dopant[.]’” *Id.*, 15 (citing ’195 Patent File Wrapper). However, the EDTX court concluded that this prosecution history was insufficient to establish that the graded dopant concentration must uniformly increase or decrease. *Id.* Whether or not the graded dopant concentration must uniformly increase or decrease has no bearing on the present IPRs.

Pet. Reply 6–7.

Petitioner argues that “Kawagoe teaches that electrons impacted by the graded dopant concentration would actually move,” and thus, whether “to aid carrier movement” requires actual movement of carriers does not change the outcome in this case. Pet. Reply 7 (citing Ex. 1007, 16:2–11).

c) *Petitioner's Reply to Patent Owner's Contentions that Petitioner's Challenge does not Account for Additional Forces*

Petitioner contends that, “even under [Patent Owner's] narrow construction requiring actual [carrier] movement (and without relying on inherency), Kawagoe would still meet the ‘to aid carrier movement’ limitation.” Pet. Reply 7. In particular, Petitioner argues:

Kawagoe says that “the impurity [or dopant] concentration is given such a gradient” so that certain electrons “*are attracted* to the substrate body 2S by that concentration gradient and prevented from entering the p-well[.]” EX1007, 16:2-11 (emphasis added). The electrons “are attracted” language means that graded dopant concentration in Kawagoe is “given such a gradient” that the electrons would affirmatively move, notwithstanding any unstated external forces.

*Id.*; *see id.* at 10 (“[T]he fact that carriers are prevented from entering the active regions in Kawagoe, such as p-well 6p, appears to be strong evidence that the downward facing electric field is not negated or reversed by other fields or forces.” (quoting IPR2024-00263, Paper 21 (Institution Decision), 19)).

Petitioner contends that Patent Owner's counter-arguments about “net forces” “rest on the flawed premise that the claims require actually moving a carrier.” Pet. Reply 9. According to Petitioner, “[b]ecause the challenged claims are all *apparatus* claims, Petitioner does not need to establish that the prior art actually moves any given carrier,” but rather, “to effectively challenge limitation [1.5], Petitioner need only show ‘a graded dopant concentration’ that is *capable* of ‘aid[ing] carrier movement from the first surface to the second surface of the substrate.’” *Id.* at 9–10 (citing IPR2023-01243, Paper 82, 36). Petitioner submits that “the prior art graded dopant

concentrations are all capable of aiding the movement of carriers in the claimed direction, notwithstanding hypothetical forces or resistances that could sometimes prevent motion.” *Id.* at 10.

*d) Petitioner’s Reply to Patent Owner’s Contentions that Kawagoe Teaches Inhibiting, not Aiding, Carrier Movement*

Petitioner stands firm that Kawagoe’s graded dopant concentration *aids* and impedes carrier movement:

[Patent Owner] repeatedly misinterprets a statement in Kawagoe that electrons are “prevented from entering the p-well 6p” by the concentration gradient, even wrongly questioning Petitioner’s candor to the Board. *See* POR, 17, 24-26 (falsely accusing Petitioner of “strategically us[ing] square brackets to conceal” aspects of Kawagoe). Petitioner is not hiding anything, and this statement in Kawagoe is perfectly consistent with Dr. Blalock’s (and Petitioner’s) position that the graded concentration in Kawagoe aids carrier movement. *Contra* POR, 22-23; *see also* EX1003, ¶91 and n.7.

Pet. Reply 14. Petitioner argues, “an electric field from a graded dopant concentration ‘aids carrier movement’ in one direction and inhibits carrier movement in the opposite direction.” *Id.*; *see id.* at 14–15 (“[Patent Owner’s] own expert explained that an electric field ‘aids movement in the direction of the field’ and ‘in [] the 180 degree opposite direction [] it will repel, and it pushes [a charge] away.’” (citing Ex. 1056, 102:2–109:14)); 15 (“As [Patent Owner’s] expert Dr. Glew admitted, whether an electric field from a graded dopant concentration aids movement or impedes movement depends on the direction of the movement.” (citing Ex. 1056, 83:13–89:13, 92:2–97:8, 102:2–109:14, 109:25–116:3, 121:19–123:15)).

Petitioner submits, “when Kawagoe says that ‘electrons produced by the  $\alpha$ -ray are attracted to the substrate body 2S by that concentration gradient

and prevented from entering the p-well,’ this means an electric field aids carrier movement ‘to the substrate body 2S’ and impedes carrier movement in the opposite direction ‘entering the p-well.’” Pet. Reply 15 (citing Ex. 1007, 16:2–11, Figs. 17, 23; Pet. 19–29, 51–58). Petitioner argues that “[t]he downward force from the graded dopant concentration in Kawagoe—which [Patent Owner’s] expert confirmed exists from the surface 0 past depth  $W_w$ —would push electrons above well 6p towards the well 6p and then towards substrate body 2S.” *Id.* at 16 (citing Ex. 1007, 16:2–11, Figs. 17, 23; Ex. 1056, 113:4–16).

e) *Petitioner’s Reply to Patent Owner’s Contentions About the Cited Underlying Evidence and Whether There are Carriers in Kawagoe’s Active Region*

According to Petitioner, “[Patent Owner’s] assertion that ‘[t]he carriers that Kawagoe describes are not in the “active region”’ is baseless.” Pet. Reply 10–11. Indeed, Petitioner submits that Patent Owner “previously admitted it would be ‘silly’ to dispute whether Kawagoe has carriers in the active region.” *Id.* (citing Paper 18, 6 (“Greenthread never said anything so silly. Of course Kawagoe’s transistor, like any transistor, will have carriers in the active region.”))).

Petitioner submits that, “[b]ecause there are electrons in the active region of Kawagoe, [Patent Owner’s] arguments above [sic: about] alpha rays not occurring in the active region are irrelevant.” Pet. Reply 12; *see id.* at 12–13.

Petitioner proffers that Patent Owner’s arguments (PO Resp. 27–28) about the Wang reference’s date should also be disregarded:

First, [Patent Owner's] argument about whether Wang "give[s] a POSITA a reason to use Kawagoe in the active region" is irrelevant because Petitioner is *not* proposing any modification of Kawagoe in view of Wang. *Contra* POR, 28. Kawagoe's Figure 17 already teaches a graded dopant concentration in the active region that will aid movement of carriers in the claimed direction—no modification is necessary. Second, regardless of Wang, [Patent Owner's] cited Nishizawa reference (issued in 1995) confirms that alpha-ray strikes generate electrons in the active region, and [Patent Owner's] expert confirmed that alpha ray strikes from cosmic rays were well known before the priority date. EX1056, 82:6-83:7, 116:4-123:15; EX2064 at 33 n.7.

Pet. Reply 13–14.

5. *Analysis of the Parties' Contentions*

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

a) *Analysis Concerning "a first active region . . . with a second doping type opposite in conductivity to the first doping type"*

With regard to the parties' arguments concerning limitation [1.2] (and by association, limitation [1.5]), we agree with Petitioner that "Kawagoe has a first active region with a doping type opposite to the substrate because the first active region identified in Figure 23 of Kawagoe has n-type doped source and drain regions, which are opposite to a p-type substrate." Pet. Reply 22 (citing Pet. 13–17, 46–49; Ex. 1056, 136:15–137:14). We agree with Petitioner that this feature in Kawagoe is consistent with Figures 5B and 5C of the '481 Patent, which Patent Owner's expert, Dr. Glew,

emphasized “clearly disclose[]” the claimed invention. Ex. 2064 ¶ 34; *see* PO Resp. 6–7.

The parties’ dispute concerns the “active region,” and in particular, if *only* the “second doping type opposite in conductivity to the first doping type” must be present in the active region. After review of the evidence of record, including the language of the claims, the written description of the ’481 patent, and the prior art of record, we find Petitioner persuasively shows that that the active region has the “second doping type” in the source and drain regions.

Claim 1 requires “a first *active region* . . . with a second doping type opposite in conductivity to the first doping type,” and is not so specific so as to require *only* the “second doping type,” nor to require the “second doping type” throughout the *entirety* of the “first active region.” Claim 1 does not require that the channel region of the active region has the “second doping type opposite in conductivity to the first doping type.” It is enough that the source and drain regions within the active region have the “second doping type.” Because the claim does not preclude the first doping type from *also* being in the source and drain regions, it is sufficient to meet the claims if the source and drain regions have the “first doping type” in the source and drain regions, *along with* the “second doping type.”

As discussed below, Petitioner persuasively demonstrates that the “active region” of a MOS device would have been understood by one of ordinary skill in the art to have dopants of the “second doping type,” in this case, n-type dopants, in the source and drain regions of the active region.

Dr. Glew testifies that “[t]he claimed invention is clearly disclosed in, e.g., Figs. 5B-5C of the Challenged Patent, and the corresponding parts of

the specification.” Ex. 2064 ¶ 34. Figure 5B of the ’481 patent depicts *n*-type source and drain regions formed within a  $P^-$  substrate, and a graded dopant region which is disclosed as “creat[ing] a drift field to sweep [] unwanted minority carriers from the active circuitry at the surface into the substrate in a monolithic die as quickly as possible.” Ex. 1001, 3:64–4:1. The ’481 patent further discloses “a graded donor concentration to sweep the minority carriers deep into the substrate” that “can be a deeply-implanted layer,” an *epitaxial layer*, an *n*-well, or a *p*-well, like Kawagoe, and when implemented in a well region, can be “graded or retrograded in dopants to sweep those carriers away from the surface as well.” *Id.* at 4:1–10. Thus, the written description of the ’481 patent supports Petitioner’s identification of the doping type of the active region being represented by the doping type of the source and drain.

Moreover, the cited underlying evidence, Wolf, supports Petitioner’s position; it describes how the skilled artisan would have understood an *nMOS* as including a source and drain that are doped with an *n*-type dopant and “[a] channel region in the semiconductor under the gate electrode[,] separat[ing] the source and drain” that “is lightly doped with a dopant type opposite to that of the source and drain.” Ex. 1008B, Fig. 5-1(a), 298 (emphasis added).

In view of the foregoing, Petitioner persuasively demonstrates that the doping type of the active region of limitation [1.2] may be identified as the doping type of the source and drain regions. *See e.g.*, Pet. Reply 22–25. Petitioner persuasively demonstrates that Kawagoe discloses a first active region (including the source and drain) having a second doping type (*n*-type) that is opposite in conductivity to the first doping type (*p*-type). Pet. 13–17.

Thus, Petitioner persuasively demonstrates that Kawagoe discloses limitation [1.2].

*b) Analysis Concerning Calculating Magnitude of Slope*

With regard to the parties' arguments concerning the "at least one graded dopant concentration to aid carrier movement" limitation, we briefly summarize the prosecution of U.S. Patent Application No. 11/622,496, the application leading to parent U.S. Patent No. 8,421,195 ("the '195 patent"). During prosecution, the Examiner rejected claims under the pre-AIA version of 35 U.S.C. § 112, first paragraph and found that "movement of minority carriers is affected by multiple forces and fields" and that "it does not appear that simply the presence of 'a unidirectional drift field' in itself can achieve 'drawing all minority carriers from said surface layer to said substrate.'" Ex. 1016, 270; *see id.* at 289. The Applicant responded with the following argument:

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

*Id.* In response to the Examiner's argument that the simple presence of a "graded dopant concentration" "does not appear to ensure

(without knowing [the] other parameters of the device) that it will draw ‘all’ minority carriers,” the Applicant responded:

[T]his 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 (emphases added). Also, “without conceding [its] position on this issue,” the Applicant amended the claims to no longer require “drawing *all* minority carriers,” and instead, requiring that the claimed “unidirectional drift field” created by the “graded concentration of dopants” “aid the movement of minority carriers.”<sup>22</sup> *Id.* at 289–290.

We determine that the statements made by the Applicant (Patent Owner) during prosecution of the ’195 parent patent were clear, unambiguous, and indicate that one of ordinary skill in the art need not know whether there are other “forces and fields” in an electronic device, as the mere presence of a graded dopant concentration creating a “unidirectional drift field,” facing in the appropriate direction, will “aid the movement of

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<sup>22</sup> The examined claims of the ’195 patent application generally recited “a unidirectional drift field drawing all minority carriers from said surface layer to said substrate.” Ex. 1016, 250. The Applicant amended the claims of the ’195 patent application to recite “maintain[ing] a single static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.” *Id.* at 286.

minority carriers from” the surface layer to the substrate. Ex. 1016, 270, 289–290. The public is entitled to rely on these clear and unambiguous statements when considering the scope of the challenged claims.

*Hockerson-Halberstadt v. Avia Group Int’l*, 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 representations when ascertaining the degree of lawful conduct, such as designing around the claimed invention.”).

We agree with Petitioner that, contrary to Patent Owner’s arguments in this proceeding, neither the specification nor the prosecution history requires a calculation of magnitude of a slope to meet the requirements of claim 1—all that is required is a determination of relative slope as described by direction. Pet. Reply 4–5, 8–18. Petitioner’s arguments about the prosecution of descendent U.S. Patent Application No. 17/728,588 (“the ’588 application”), an application that claims priority to both the ’481 patent and the ’195 patent, are similarly persuasive. During prosecution of the ’588 application, Patent Owner asserted that “‘relative slope’ . . . means nothing more than the fact that one-side is relatively lower than the other side.” Ex. 1058, 12; *see* Pet. Reply 4–5 (citing Ex. 1058, 12; Ex. 1059, 5).

Based on the complete record developed during trial, Patent Owner’s statements during prosecution of the ’195 patent and ’588 application, along with the specification of the ’481 patent, support a determination that a graded dopant concentration is enough to teach aiding carrier movement in a particular direction. We observe, in that regard, that the inventor “did not provide the type of detail in” the ’481 patent’s specification that Patent

Owner “now argues is necessary in [the] prior art references.” *In re Epstein*, 32 F.3d 1559, 1568 (Fed. Cir. 1994).

Claim 1 also does not require the movement of any particular number of carriers, let alone a need to move all the carriers. On this point, we note that independent claim 1 is not a method claim—as Petitioner’s counsel emphasized during the hearing. Tr. 10:12–14; 23:18–21.

In *ParkerVision*, the Court emphasized that “[a]pparatus claims cover what a device *is*, not what a device *does*.” *ParkerVision*, 903 F.3d at 1361. That is, to effectively challenge claim 1, Petitioner must show that “the reference discloses an apparatus that is reasonably capable of operating so as to meet the claim limitations, *even if it does not meet the claim limitations in all modes of operation*.” *Id.* (emphasis added).

Petitioner must show “a graded dopant concentration” that is *capable* of “aid[ing] carrier movement from the first surface to the second surface of the substrate.” We are persuaded Petitioner has done so by showing that Kawagoe discloses a graded dopant concentration with a slope, in a particular direction, in Figures 17 and 23 of Kawagoe that is not only reasonably capable, but actually does, move carriers in the claimed direction.

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 “[t]he Western District of Texas unequivocally stated, ‘a graded concentration . . . that is [not “sufficiently graded”] will not aid in the movement of minority carriers,’” 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 18–19 (citing Ex. 2080, 39–40; Ex. 2082, 15).

Before the Western District of Texas, 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. Ex. 2080, 32. Patent Owner argued in response that the patent provides sufficient guidance as to the meaning of the claim term, with “graded” meaning varying or not “uniform.” *Id.* at 37–38 (“[Patent Owner] 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 graded dopant concentration must 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 U.S. Patent No. 8,421,195. *Id.* at 39–40.

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 was not addressing the same argument raised by Patent Owner in this proceeding. Rather, it was addressing whether the term “graded dopant concentration” is indefinite. 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 claims then at issue, 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.” Ex. 2080, 39–40; Ex. 1020, 35 (“[A person of ordinary skill in the art] would have readily recognized that when a ‘static unidirectional electric drift field’ is present that it aids the movement of minority carriers. If it isn’t present, then it doesn’t.”), 37 (“The intrinsic record consistently confirms that the electric fields aid the movement of the carriers.”).

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. The plaintiff 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 to 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. *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.” *Id.* at 15. In rejecting this argument, the Court found that the patentee 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 appears consistent with both the Applicant’s assertions during prosecution and Petitioner’s arguments in this proceeding, i.e., that “a graded dopant concentration” will “aid carrier movement” as recited in claim 1.

*c) Analysis Concerning Accounting for Additional Forces*

Patent Owner finds fault in Petitioner’s application of Kawagoe to claim 1’s limitation of a “graded dopant concentration to aid carrier movement,” because allegedly Kawagoe does not teach an assessment of “all” forces that might act on carriers to show that its carriers move at all (despite the graded dopant concentration). *See, e.g.*, PO Resp. 18 (“[I]f the forces acting on a carrier—i.e. the force exerted by a gradient and *any other forces*—cancel each other out, the carriers do not move at all.” (emphasis added)). We find Patent Owner’s “net forces” line of arguments unavailing.

We agree with Petitioner that, “even under [Patent Owner’s] narrow construction requiring actual [carrier] movement (and without relying on inherency), Kawagoe would still meet [(i.e., teach or at least fairly suggest)] the ‘to aid carrier movement’ limitation.” Pet. Reply 7. Kawagoe discloses:

[T]he 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  $\alpha$ -ray is lowered. Specifically, the electrons produced by the  $\alpha$ -ray *are attracted to the substrate body 2S by that concentration gradient* and prevented from entering the p-well 6p.

Ex. 1007, 16:2–11 (emphasis added). We agree with Petitioner that “[t]he electrons ‘are attracted’ language means that [the] graded dopant concentration in Kawagoe is ‘given such a gradient’ that the electrons would affirmatively move, notwithstanding any unstated external forces.” Pet. Reply 7. We find Kawagoe’s disclosure that carriers are prevented from entering the active regions, such as p-well 6p, is strong (let alone sufficient) evidence that the downward facing electric field is not negated or reversed by other fields or forces.

We also agree with Petitioner that Patent Owner’s “net forces” arguments “rest on the flawed premise that the claims require actually moving a carrier.” Pet. Reply 9. Because the challenged claims are all *apparatus* claims, we find Petitioner does not need to show that Kawagoe teaches actually moving any given carrier (although it does do so). *See ParkerVision*, 903 F.3d at 1361 (“We explained long ago that ‘[a]pparatus claims cover what a device *is*, not what a device *does*.’” (quoting *Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F.2d 1464, 1468 (Fed. Cir. 1990))). Rather, Petitioner need only show that Kawagoe teaches or at least fairly suggests a “graded dopant concentration” that is *reasonably capable* of “aid[ing] carrier movement from the first surface to the second surface of the substrate.” *See id.* at 9–10; *ParkerVision*, 903 F.3d at 1361 (“[A] prior art reference may anticipate or render obvious an apparatus claim . . . 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.” (emphasis added)). Petitioner persuasively argues that “the prior art graded dopant concentrations are all capable of aiding the movement of carriers in the claimed direction, notwithstanding

hypothetical forces or resistances that could sometimes prevent motion.”

Pet. Reply 10.

*d) Analysis Concerning Kawagoe’s Teachings Regarding Aiding or Inhibiting Carrier Movement*

As to the parties’ arguments concerning whether Kawagoe discloses aiding or inhibiting the movement of carriers, Petitioner persuasively argues “an electric field from a graded dopant concentration ‘aids carrier movement’ in one direction and inhibits carrier movement in the opposite direction.” Pet. Reply 14. Petitioner also persuasively argues that that “is exactly what Kawagoe says: because of the concentration gradient electrons are **both** ‘attracted to the substrate body 2S’ (i.e., movement aided) **and** ‘prevented from entering the p-well.’ (i.e., movement inhibited).” *Id.* at 14–15 (citing Ex. 1007, 16:2–11). We determine that Patent Owner’s expert, Dr. Glew, also agrees. *See, e.g.*, Ex. 1056, 109:6–14 (Dr. Glew testifying that an electric field “aids movement in the direction of the field” and “in [] the 180 degree opposite direction [] it will repel, and it pushes [a charge] away.”), 103:20–104:4, 104:7–16, 105:22–106:6.

Patent Owner’s litigation position also supports our determination on this issue: “Electric drift fields are a well-known phenomenon that cause carriers to move, and a POSITA would have readily recognized that when a ‘static unidirectional electric drift field’ is present that it aids the movement of the minority carriers. If it isn’t present, then it doesn’t.” Ex. 1020, 26 (Patent Owner’s Responsive Claim Construction Brief in a related litigation, *supra* § II.B). Patent Owner’s litigation position is also that “[t]he drift field points to one direction and charge carriers, when free to move, respond to the drift field by moving in *one direction or the other depending on their*

*charge polarity.” Id. at 27 (emphasis added).* More particularly, Patent Owner contends in the related litigation:

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

*Id. at 28 (emphasis added).* Thus, we find Patent Owner’s “inhibiting carrier movement” line of arguments unavailing in this case and inconsistent with positions taken in related litigation.

e) *Analysis Concerning the Cited Underlying Evidence and Whether There are Carriers in Kawagoe’s Active Region*

We agree with Petitioner that Kawagoe teaches or at least fairly suggests carriers in the “active region,” and that Patent Owner’s contentions to the contrary lack merit. *See* Pet. Reply 10–11. Indeed, as argued by Petitioner, Patent Owner “previously admitted it would be ‘silly’ to dispute whether Kawagoe has carriers in the active region.” *Id.* (citing Paper 18, 6 (“[Patent Owner] never said anything so silly. Of course Kawagoe’s transistor, like any transistor, will have carriers in the active region.”)). Petitioner submits, and we agree, that, “[b]ecause there are electrons in the active region of Kawagoe, [Patent Owner’s] arguments above [sic: about] alpha rays not occurring in the active region are irrelevant.” Pet. Reply 12; *see id.* at 12–13.

As for Petitioner’s reference to supporting evidence like the Wang reference on this point, we agree with Petitioner: “[Patent Owner’s]

argument about whether Wang ‘give[s] a POSITA a reason to use Kawagoe in the active region’ is irrelevant because Petitioner is *not* proposing any modification of Kawagoe in view of Wang.” Pet. Reply 13–14. As we discuss above, Petitioner shows persuasively that Kawagoe’s Figure 17 already teaches or at least fairly suggests a graded dopant concentration in the active region that will aid movement of carriers in the claimed direction—no modification is necessary. *See supra* §§ IV.E.5.b–5.d

6. *Conclusion for Independent Claim 1*

In view of the foregoing and notwithstanding Patent Owner’s proffered objective indicia of nonobviousness discussed above, we are persuaded that Petitioner establishes, by a preponderance of the evidence, that claim 1 is unpatentable as obvious over Kawagoe. As discussed above in Section IV.D, Patent Owner’s objective indicia of nonobviousness are entitled to little weight (even considering nexus to exist), but even if we were to give them more weight, they still would not overcome Petitioner’s strong showing of obviousness.

7. *Independent Claim 20*

Petitioner relies on substantially the same cited teachings in Kawagoe for teaching the limitations of independent claim 20. Pet. 7–29.

Independent claim 20 includes most of the same limitations in independent claim 1 and three limitations not included in claim 1. Limitation [20.2] of independent claim 20 recites “a first active region disposed adjacent the first 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, 5:57–60 (emphasis added).

Limitation [20.3] of independent claim 20 recites “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*.” *Id.* at 6:1–3 (emphasis added). Limitation [20.5] of independent claim 20 recites “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 surface to the substrate*.” *Id.* at 6:6–9 (emphasis added).

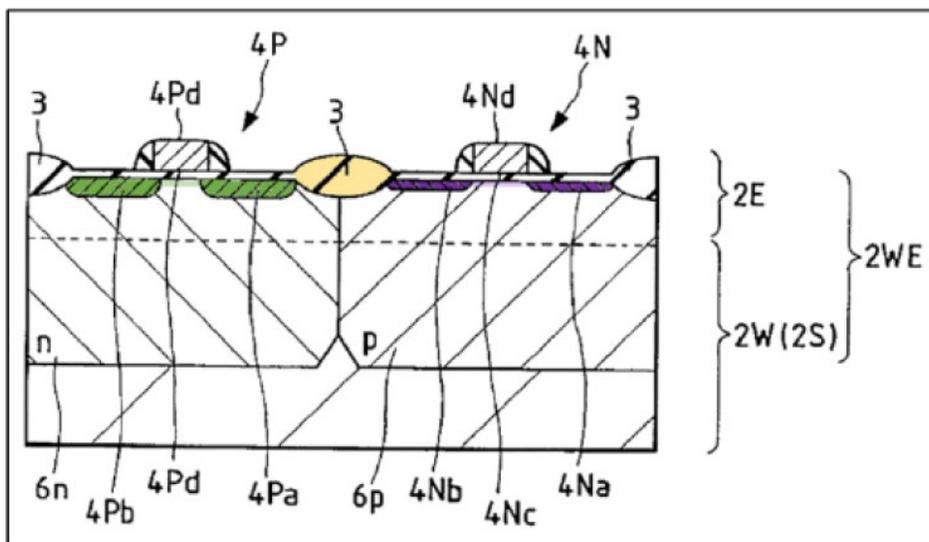
Pointing to its annotated versions of Kawagoe’s Figure 23, reproduced below, Petitioner contends Kawagoe discloses “nMOS transistor 4N . . . formed in the surface of the first active region” and “pMOS transistor 4P . . . formed in the surface of the second active region.” Pet. 14–15, 17–18 (citing Ex. 1003 ¶¶ 78, 83).



8. *Dependent Claims 6 and 26*

Claims 6 and 26 recite “wherein the first active region and second active region are each separated by at least one isolation region.” Ex. 1001, 5:16–18, 6:30–32. Patent Owner presents arguments for these claims. PO Resp. 37–39.

Petitioner argues Kawagoe’s field insulating film 3, annotated in yellow in Kawagoe’s Figure 23, as reproduced below, teaches or at least fairly suggests the claimed “isolation region.”



Petitioner’s annotated version of Kawagoe’s Figure 23 depicting field insulating film. Pet. 32.

Patent Owner argues that the “Petition fails to appreciate that regions 4Na and 4Nb, which ‘are regions for forming the source-drain regions of the nMOS 4N’ . . . ‘are made as deep as about 0.5  $\mu\text{m}$  and *formed in the range of the thickness of the epitaxial layer 2E.*” PO Resp. 38 (citing Ex. 1007, 8:66–67, 9:3–6). According to Patent Owner, “Kawagoe provides similar disclosure regarding regions 4Pa and 4Pb.” *Id.* (citing Ex. 1007, 9:47–53). Patent Owner concludes:

[A] POSITA would have understood that the first and second active regions extend to about the depth of the epitaxial layer 2E and abut each other laterally, and therefore they are not separated by Kawagoe's field insulating film 3, as required by claims 6 and 27. The field insulating film 3 is formed "[o]ver the principal surface of the epitaxial layer 2E" . . . and a POSITA would have understood that it does not extend deep enough to separate the two active regions.

PO Resp. 38–39 (citing Ex. 1007, 8:40–42).

We find Petitioner has the better position, for the simple reason that the claims do not require the "isolation region" to completely separate the active regions, that is, that the isolation region extends to a depth that is the same as or deeper than the depth of the active regions. The claimed "isolation region" is not defined or set forth in the specification, only in the claims. 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. Pet. Reply 27 (citing Ex. 1007, 8:43–45; Ex. 1056, 142:4–143:11). Petitioner persuasively demonstrates that these two structures, in combination, also act as an isolation region. *Id.*

In view of the foregoing and notwithstanding Patent Owner's proffered objective indicia of nonobviousness discussed above, we determine that Petitioner establishes obviousness of claims 6 and 26 over Kawagoe by a preponderance of the evidence.

9. *Remaining Dependent Claims*

Claims 2–5, 7–9, 13, 14, 16–19, 21–25, 27, and 31–36 depend directly or indirectly from independent claims 1 or 20. Ex. 1001, 5:4–6:59. The Petition provides a detailed assessment of these claims, with references to the Petition’s analysis of claims 1 and 20, disclosures in Kawagoe, and the declaration testimony of Dr. Blalock. Pet. 29–40. Patent Owner does not contend that the limitations in claims 2–5, 7–9, 13, 14, 16–19, 21–25, 27, and 31–36 are absent in Kawagoe, and therefore, has waived such arguments.<sup>23</sup> *See generally* PO Resp.; PO Sur-reply. As discussed above, we are persuaded that the cited evidence sufficiently supports Petitioner’s contentions that independent claims 1 and 20 would have been unpatentable as obvious over Kawagoe, and also are persuaded that the cited evidence sufficiently shows claims 2–5, 7–9, 13, 14, 16–19, 21–25, 27, and 31–36 likewise obvious. For the same reasons provided above for independent claims 1 and 20, and the reasons set forth in the Petition (Pet. 29–40), and notwithstanding Patent Owner’s proffered objective indicia of nonobviousness discussed above, we conclude that Petitioner has demonstrated by a preponderance of the evidence that dependent claims 2–5, 7–9, 13, 14, 16–19, 21–25, 27, and 31–36 would have been unpatentable as obvious over Kawagoe.

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<sup>23</sup> *In re NuVasive, Inc.*, 842 F.3d 1376, 1379–82 (Fed. Cir. 2016) (holding that patent owner waived arguments on an issue that were not raised in its response after institution); *see also Papst Licensing GmbH & Co. KG v. Samsung Elecs. Am., Inc.*, 924 F.3d 1243, 1250 (Fed. Cir. 2019) (holding patent owner forfeited argument for patentability not presented to the Board); *Bradium Techs. LLC v. Iancu*, 923 F.3d 1032, 1048 (Fed. Cir. 2019) (explaining that arguments not presented to the Board are waived).

*F. Obviousness of Claims 1, 2, 4–9, 13–22, 24–27, and 31–36 over the Combination of Wieczorek and Wolf*

Petitioner contends claims 1, 2, 4–9, 13–22, 24–27, and 31–36 would have been obvious over the combination of Wieczorek and Wolf. Pet. 6, 40–71; Pet. Reply 20–22. Patent Owner opposes Petitioner’s contentions. PO Resp. 11–35; PO Sur-reply 11–14. For the reasons expressed below, and based on the complete record before us, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 1, 2, 4–9, 13–22, 24–27, and 31–36 are unpatentable as obvious over the combination of Wieczorek and Wolf. We turn first to overviews of Wieczorek and Wolf.

*1. 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. The Petition relies on Wieczorek’s description of the prior art, not its disclosed improvement. Pet. 41.

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.” Ex. 1006 ¶ 6. According to Wieczorek, a retrograde channel dopant profile is desirable, but “very difficult to obtain.” *Id.* Wieczorek states 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 Wiczorek uses to illustrate the prior art.

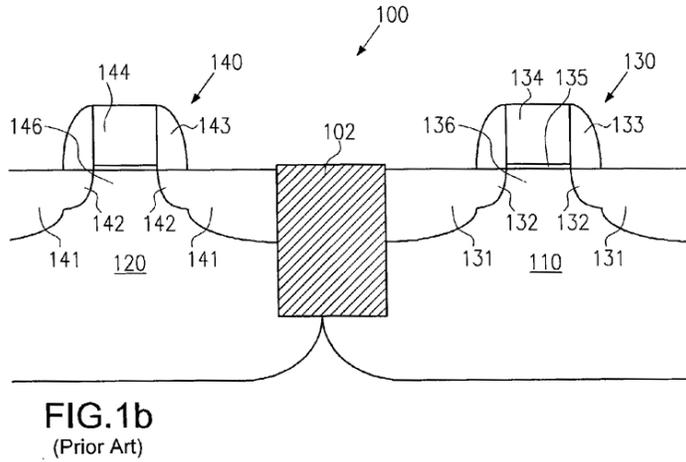


FIG. 1b  
(Prior Art)

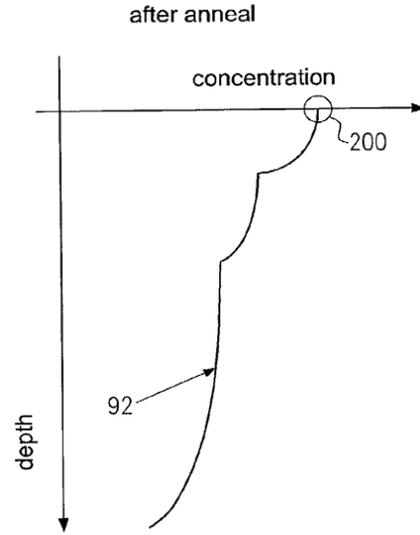


FIG. 2b  
(Prior Art)

Wiczorek Figure 1b shows a conventional semiconductor device at an advanced manufacturing stage, including shallow trench isolation 102 separating N-well structure 120 from P-well structure 110. Ex. 1006 ¶¶ 7, 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. *Id.* ¶ 12. Wiczorek 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. *Id.* ¶¶ 9–11, 13, 21.

2. *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. Ex. 1008A, 807–840.

3. *Petitioner’s Contentions for Independent Claim 1*

Petitioner argues that the combination of Wieczorek and Wolf teaches or at least fairly suggests the limitations of claim 1 and that a person of ordinary skill in the art would have had a rational reason to combine the teachings of Wieczorek and Wolf with a reasonable expectation of success in doing so. Pet. 40–58.

*Reason to Combine Wieczorek and Wolf*

Petitioner contends:

A POSITA would have been motivated to combine Wieczorek with Wolf. [EX1003], ¶127-128. Th[e] Petition relies on Wieczorek’s description of a conventional prior-art CMOS device. EX1006, [0020]-[0021], [0004] (“Field effect transistors, such as MOS transistors, represent one of the most frequently used circuit elements in modem [*sic*] integrated circuits.”), [0007]-[0008] (describing “[a] typical process flow for forming the semiconductor device 100” which is “a complementary MOS transistor pair”), [0012], FIG. 1b. Wolf is a well-known textbook that teaches known fundamental features and concepts related to semiconductor manufacturing, with particular emphasis on CMOS devices. *See generally* EX1008A; *id.*, Chapter 16 (“CMOS Process Integration”); EX1003, ¶128. A POSITA would have therefore understood and expected that the teachings of Wolf would apply to Wieczorek’s conventional CMOS device. *Id.* A POSITA would have looked to Wolf for additional details related to conventional CMOS devices, as detailed below. *Id.*

Pet. 40–41. Petitioner further contends:

Because Wieczorek does not specify what constitutes an appropriate substrate, a POSITA would have been motivated to consult Wolf, which confirms that a “*uniform*, lightly doped *p*- or *n*-type substrate” is commonly used in twin-well CMOS devices. EX1008C, 523, 530 (“With the twin-tub [(twin-well)] approach, two separate wells are formed for *n*- and *p*-channel transistors on a lightly doped substrate ... of *n* or *p* material.”); EX1008B, 387-389; EX1003, ¶132.

*Id.* at 43; *see id.* at 44 (explaining additional reasons for combining Wieczorek and Wolf). Petitioner also argues the skilled artisan would have had a reasonable expectation of success in combining the teachings of Wieczorek and Wolf, “because Wolf shows that [the skilled artisan] would have known how to use a uniformly doped *n*- or *p*-type substrate to form a twin-well CMOS device similarly as described in Wieczorek.” *Id.* at 44–45.

Patent Owner does not dispute Petitioner’s rationale for combining Wieczorek and Wolf or expectation of success in doing so. *See* PO Resp. 33–35; *see generally* PO Resp. Based on Petitioner’s persuasive contentions and evidence, we determine that Petitioner shows sufficiently that a person of ordinary skill in the art would have had a rational reason to combine the teachings of Wieczorek with those of Wolf with a reasonable expectation of success in doing so.

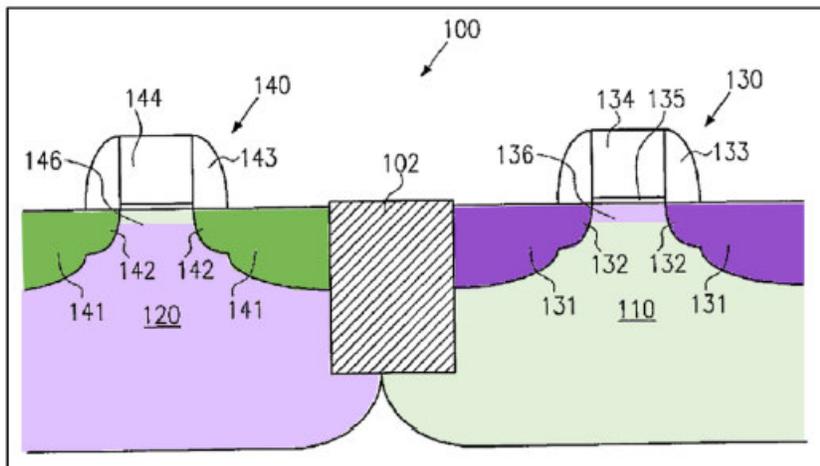
[1.pre] “[a] semiconductor device.”

Petitioner contends that “[t]o the extent it is limiting, Wieczorek discloses the preamble because Wieczorek teaches a ‘semiconductor device.’” Pet. 41 (citing Ex. 1006, code (54), ¶¶ 2, 12; Ex. 1003 ¶ 129). Petitioner further contends that “Wieczorek’s Figure 1b illustrates a conventional twin-well CMOS semiconductor device.” Pet. 41 (citing Pet. § VII.B.1.b).

Patent Owner does not contest Petitioner’s evidence pertaining to the preamble of claim 1. Based on the complete record developed during trial, we determine that Petitioner demonstrates by a preponderance of the evidence that the combination of Wieczorek and Wolf teaches the subject matter of the preamble of claim 1. As such, we need not and do not determine whether the preamble of claim 1 is limiting.

*[1.1] “a substrate of a first doping type at a first doping level having first and second surfaces.”*

Petitioner contends that its annotated version of “Wieczorek’s Figure 1b [reproduced below] illustrates a twin-well CMOS device, where N-channel transistor 130 (nMOS) with source/drain regions 131-132 (purple) and channel region 136 (light purple) is formed in P-well 110 (light green), and P-channel transistor 140 (pMOS) with source/drain regions 141-142 (green) and channel region 146 (light green) is formed in N-well 120 (light purple).” Pet. 42–43 (citing Ex. 1006 ¶¶ 7, 12, 20–21; Ex. 1008C, 525, Fig. 8-1(e); Ex. 1003 ¶ 130).



Petitioner’s annotated version of Wieczorek’s Fig. 1b.  
Pet. 43.

Petitioner contends that a “POSITA would have understood that a twin well approach ‘is independent of starting material type’ for the substrate.” *Id.* at 43 (citing Ex. 1008C, 524; Ex. 1006 ¶ 4; Ex. 1003 ¶ 131). According to Petitioner, “[b]ecause Wieczorek does not specify what constitutes an appropriate substrate, a POSITA would have been motivated to consult Wolf, which confirms that a ‘*uniform*, lightly doped *p*- or *n*-type substrate’ is commonly used in twin-well CMOS devices.” *Id.* (citing Ex. 1008C, 523, 530 (“With the twin-tub [(twin-well)] approach, two separate wells are formed for *n*- and *p*-channel transistors on a lightly doped substrate . . . of *n* or *p* material.”); Ex. 1008B, 387–389; Ex. 1003 ¶ 132).

Petitioner contends that “[c]onsistent with Wieczorek’s teaching, a POSITA would have found it obvious to use a uniformly doped *n*- or *p*-type substrate (‘a substrate of a first doping type at a first doping level’) as a suitable substrate for Wieczorek’s CMOS device in Figure 1b.” Pet. 44 (citing Ex. 1003 ¶ 133).

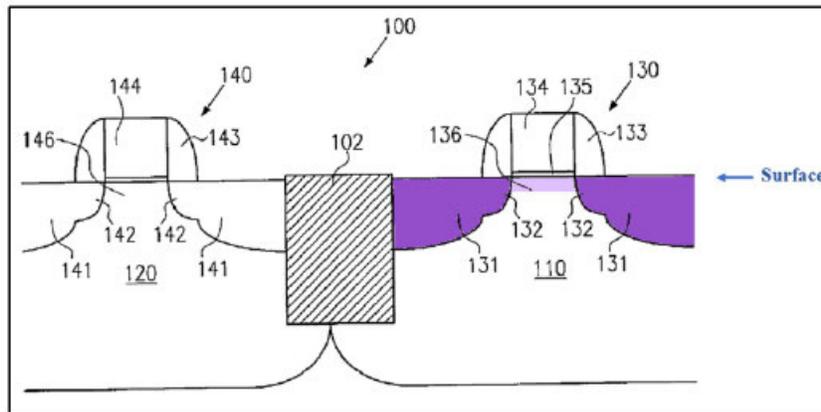
Doing so would amount to combining known prior art elements (*i.e.*, use of a uniform, lightly doped *n*- or *p*-type substrate with Wieczorek’s process for forming a conventional CMOS device) according to known methods (*i.e.*, known use of an “appropriate substrate” for the conventional process of forming the CMOS device in Wieczorek [0007]-[0013]) to obtain predictable results (*i.e.*, conventional CMOS device in Wieczorek’s Figure 1b). EX1003, ¶133. Doing so would have also been 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. *Id.* There would have been reasonable expectation of success because Wolf shows that a POSITA would have known how to use a uniformly doped *n*- or *p*-type substrate to form a twin-well CMOS device similarly as described in Wieczorek. *Id.*

Pet. 44–45.

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.1]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that the combination of Wieczorek and Wolf teaches this limitation of claim 1.

*[1.2] “a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed.”*

Petitioner contends that “Wieczorek discloses ‘an N-channel 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). Petitioner further contends “[t]he source-drain regions 131-132 (purple) form part of the claimed first active region, which also includes channel region 136 (light purple) between them.” *Id.* (citing Ex. 1006 ¶ 12; Ex. 1003 ¶ 136; Ex. 1008B, 299, 300, Figs. 5-2, 6-8(c), 6-10; Ex. 1008C, 525, Fig. 8-1(e)). Pointing to Petitioner’s annotated version of Wieczorek’s “Figure 1b [reproduced below], nMOS transistor 130 is formed in the surface of the first active region, which is adjacent the first surface of the substrate.” Pet. 47 (citing Ex. 1003 ¶ 136).



Petitioner's annotated version Figure 1b of  
Wieczorek. Pet. 47.

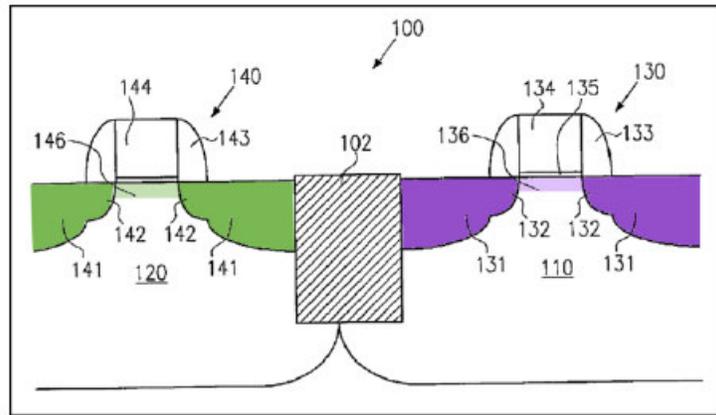
According to Petitioner, “[b]ecause the source-drain regions of the first active region are N-doped, Wieczorek-Wolf’s first active region has a second doping type (N-type) opposite in conductivity to the first doping type (P-type) of the substrate.” *Id.* (citing Ex. 1006 ¶ 12; Ex. 1003 ¶ 137); *see id.* at 47–49.

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.2]. We determine that Petitioner establishes by a preponderance of the evidence that the combination of Wieczorek and Wolf teaches this limitation of claim 1.

*[1.3] “a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed.”*

Petitioner contends that “‘Wieczorek discloses ‘P-channel transistor 140,’ including ‘heavily P-doped source and drain regions 141, including lightly doped extensions 142,’ and ‘channel region 146.’” Pet. 49 (citing Ex. 1006 ¶¶ 4, 7, 12, 13; Ex. 1003 ¶ 141). “Source and drain regions 141-142 (green) are part of the claimed second active region, which also includes channel region 146 (light green) between them.” *Id.* (citing

Ex. 1006 ¶ 12; Ex. 1008B, 298–301, Figs. 5-1, 5-2, 6-4; Pet. § VII.B.1.c; Ex. 1003 ¶ 141). Petitioner contends that as shown in its annotated version of Wieczorek’s Figure 1b reproduced below, “pMOS transistor 140 is formed in the surface of the second active region (green/light green), which is separate from and disposed adjacent to the first active region (purple/light purple).” Pet. 49 (citing Ex. 1006 ¶ 12; Ex. 1003 ¶ 142).



Petitioner’s annotated version of Figure 1b  
of Wieczorek. Pet. 50.

“Adjacent active regions are separated by an isolation region (*e.g.*, shallow trench isolation 102).” *Id.* (citing Ex. 1006 ¶ 7; Ex. 1008A, 818–20, Fig. 16-11(f); Ex. 1001, cl. 6, 26; Ex. 1003 ¶ 142; Pet. § VII.A.1.d).

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.3]. We determine that Petitioner establishes by a preponderance of the evidence that the combination of Wieczorek and Wolf teaches this limitation of claim 1.

*[1.4] “transistors formed in at least one of the first active region or second active region.”*

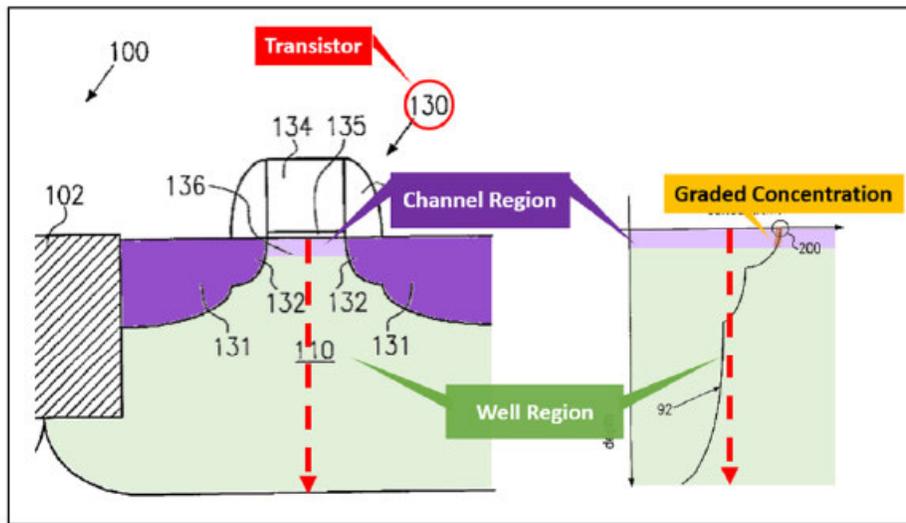
Petitioner relies on its arguments for limitations [1.2] and [1.3] for teaching limitation [1.4]. Pet. 51 (citing Pet. §§ VII.B.c–d). Wieczorek

discloses forming N-channel and P-channel transistors, each in an active region, as discussed above. Ex. 1006 ¶¶ 12–13, Fig. 1b.

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.4]. For the same reasons discussed above for limitations [1.2] and [1.3], we determine that Petitioner establishes by a preponderance of the evidence that the combination of Wieczorek and Wolf teaches this limitation of claim 1.

*[1.5] “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 surface to the second surface of the substrate.”*

Petitioner contends that, in Petitioner’s annotated versions of Wieczorek’s Figures 1b and 2b reproduced below, “channel region 136 (light purple) of nMOS transistor 130, formed at the top surface of the substrate, is a portion of the first active region.” Pet. 51 (citing Ex. 1006 ¶¶ 4, 12, 13; Ex. 1008B, 298–301 (“The top surface of the [substrate] body consists of *active* or *transistor* regions as well as *passive* or (*field*) regions. The *active regions* are those in which transistor action occurs; i.e., the *channel* and the heavily doped *source and drain* regions.”), Fig. 5-2; Ex. 1003 ¶ 146).



Petitioner’s annotated versions of Wieczorek’s  
Figures 1b and 2b. Pet. 52.

According to Petitioner, “[t]he doping concentration in the channel region is highlighted in brown in the doping profile of Figure 2b (above right), measured for example along the red dotted line in Figure 1b that traverses the channel region.” *Id.* (citing Ex. 1006 ¶¶ 9, 11, 13, Fig. 2a). Petitioner contends that, as its annotated version of Wieczorek’s Figure 2b shows, “the dopant concentration is highest at the surface of the substrate and decreases with depth” and “[t]herefore, channel region 136 has a graded dopant concentration.” *Id.* (citing Ex. 1003 ¶ 147); *see id.* at 52–55.

Petitioner relies on the prosecution history of the ’481 patent concerning the “at least one graded dopant concentration to aid carrier movement” limitation in substantially similar fashion as set forth above in Section IV.E with respect to Petitioner’s challenge based on Kawagoe. Pet. 54–55.

Patent Owner disputes Petitioner’s evidence pertaining to limitation [1.5]. We resolve the dispute about this limitation in our analysis below.

*[1.6] “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 first surface to the second surface of the substrate.”*

Pointing to its annotated version of Figure 1b of Wieczorek, Petitioner contends that “Wieczorek discloses a ‘P-well structure 110’ (light green) adjacent to the first active region (purple/light purple).” Pet. 56 (citing Ex. 1006 ¶¶ 12, 13; Ex. 1003 ¶ 154). Petitioner also contends that “the dopant concentration in P-well 110—measured along the exemplary red dotted line in Figure 1b—is gradually decreasing with depth.” *Id.* (citing Ex. 1006 ¶¶ 9, 11, 13; Ex. 1003 ¶ 154). Thus, according to Petitioner, “Wieczorek discloses a well region containing at least one graded dopant region (*e.g.*, the region highlighted in light green in both Figures 1b and 2b) having a downward-sloping graded dopant concentration.” *Id.* (citing Ex. 1003 ¶ 154; Ex. 1006, Figs. 1b, 2b).

Patent Owner disputes Petitioner’s evidence pertaining to limitation [1.6]. We resolve the dispute about this limitation in our analysis below.

#### 4. *Patent Owner’s Arguments*

Patent Owner contends that Petitioner’s “Wieczorek grounds fail for similar reasons as the Kawagoe grounds,” including because “Wieczorek does not have a graded dopant concentration in the active region.” PO Resp. 33. Patent Owner argues the doping profile (gradient) in the active

region in Wieczorek “may have become substantially uniformly distributed,” and even if that specific area of doping concentration were “graded,” “nothing in Wieczorek discusses using grading to affect carrier movement.” *Id.*; see PO Sur-reply 11 (“Wieczorek *never* mentions moving carriers, much less moving carriers from the ‘active region.’ Petitioner provides *no* citations to the specification for this point.”), 12 (“[T]he line in ‘reference 200’ appears just as ‘straight’ as the horizontal straight line above it.”), 13 (“Even if the line in ‘reference 200’ is graded (which it is not), Wieczorek never mentions using the grading to affect carrier movement.”). Patent Owner argues that “[t]o establish the ‘aid carrier movement’ part of the limitation, the Petition relies entirely on [Patent Owner’s] supposed admissions.” PO Resp. 33–34. Patent Owner again also faults Petitioner’s expert, Dr. Blalock, for not “calculate[ing] the slope of the graded concentration curve in Wieczorek.” *Id.* at 34.

#### 5. *Petitioner’s Reply Arguments*

Petitioner contends 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 20 (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.* (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).”).

More importantly, 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. Petitioner argues that “area 200 is shown *to occupy only a small portion of the active region.*” *Id.* at 21 (emphasis added). We agree and find 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 infra* § IV.F.6.

Petitioner argues as to Patent Owner’s other arguments against Wieczorek that they “fail for the same reasons” as discussed above in Section IV.E concerning Kawagoe. Pet. Reply 21–22 (discussing creating electric fields, unidentified forces (net forces), and particular slope). In particular, Petitioner relies on its contentions for the Kawagoe challenge to support its showing that Wieczorek teaches the claimed “graded dopant concentration to aid carrier movement.” *Id.*

#### 6. *Analysis of the Parties’ Arguments*

For the same reasons set forth above in Section IV.E.5, Patent Owner’s arguments are unavailing. That is, no particular magnitude or specific numerical value of slope must be shown in order to satisfy the claims. Petitioner sufficiently shows that the combination of Wieczorek and Wolf teaches the relative slope encompassed by the scope of independent claim 1. Our reasoning above, presented in the context of the ground based on Kawagoe, applies with equal force here. *See, e.g., supra* § IV.E.5.b

(discussing magnitude of slope), § IV.E.5.c (discussing unidentified and net forces), § IV.E.5.d (discussing aiding carrier movement), § IV.E.5.e (discussing carriers in the active region).

7. *Conclusion for Independent Claim 1*

In view of the foregoing and notwithstanding Patent Owner's proffered objective indicia of nonobviousness discussed above, we are persuaded that Petitioner establishes, by a preponderance of the evidence, that claim 1 is unpatentable as obvious over the combination of Wieczorek and Wolf.

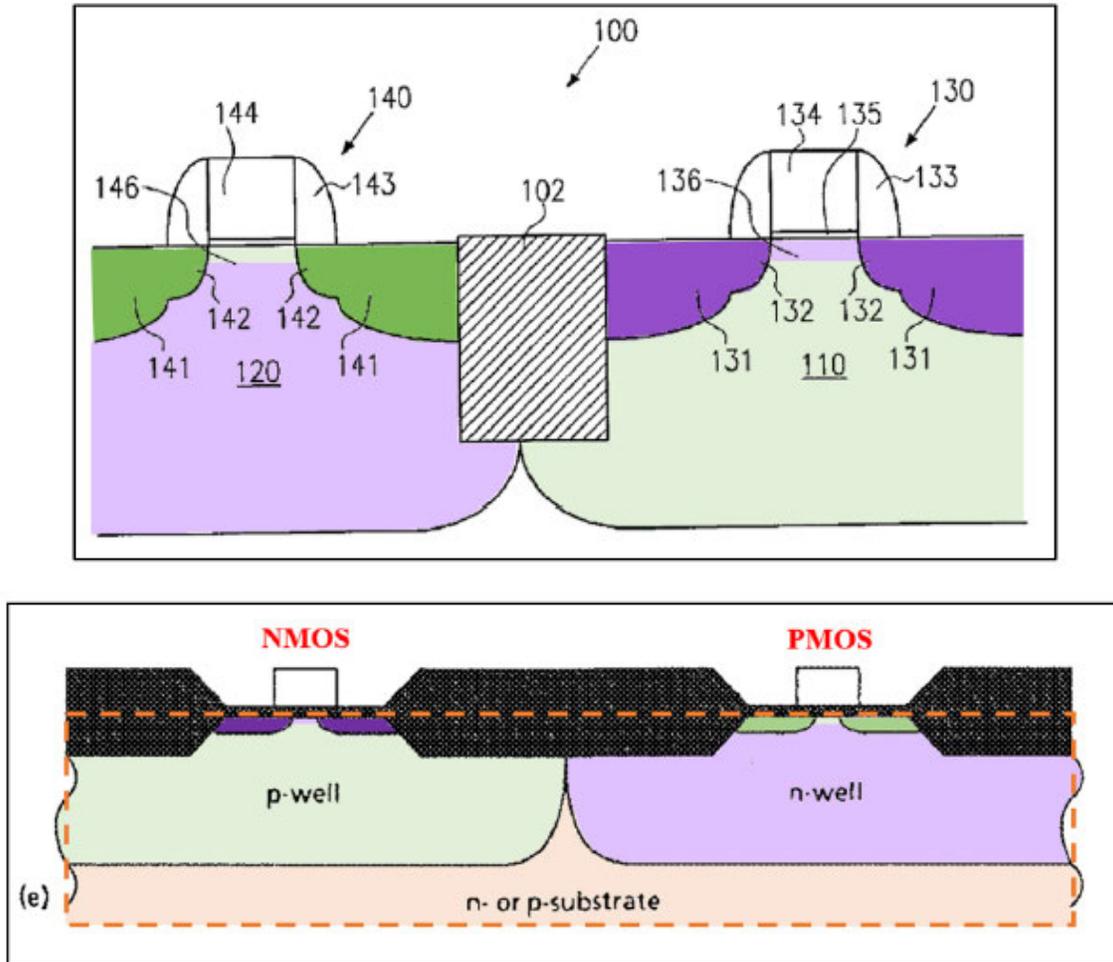
8. *Independent Claim 20*

Petitioner relies on substantially the same cited teachings in the combination of Wieczorek and Wolf for teaching the limitations of independent claim 20. Pet. 41–58.

Independent claim 20 includes most of the same limitations in independent claim 1 and three limitations not included in claim 1. Limitation [20.2] of independent claim 20 recites “a first active region disposed adjacent the first 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, 5:57–60 (emphasis added). Limitation [20.3] of independent claim 20 recites “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*.” *Id.* at 6:1–3 (emphasis added). Limitation [20.5] of independent claim 20 recites “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 surface to the substrate.*” *Id.* at 6:6–9 (emphasis added).

Pointing to its annotated versions of Wieczorek’s Figure 1b and Wolf’s Figure 8-1(e) reproduced below, Petitioner contends “[c]onsistent with Wieczorek’s teaching, a POSITA would have found it obvious to use a uniformly doped n- or p-type substrate (‘a substrate of a first doping type at a first doping level’) as a suitable substrate for Wieczorek’s CMOS device in Figure 1b.” Pet. 44 (citing Ex. 1003 ¶ 133).



Wieczorek’s (Ex. 1006) Figure 1b (top) and Wolf’s (Ex. 1008C, 525) Figure 8-1(e) (bottom) as annotated by Petitioner.

Patent Owner does not present specific arguments for independent claim 20 beyond what is presented for independent claim 1. *See generally* PO Resp. In view of the above and notwithstanding Patent Owner's proffered objective indicia of nonobviousness discussed above, we determine that Petitioner establishes, by a preponderance of the evidence, that independent claim 20 is unpatentable as obvious over the combination of Wieczorek and Wolf.

#### 9. *Remaining Dependent Claims*

Claims 2, 4–9, 13–19, 21, 22, 24–27, and 31–36 depend directly or indirectly from independent claims 1 or 20. Ex. 1001, 5:4–6:59. The Petition provides a detailed assessment of these claims, with references to the Petition's analysis of claims 1 and 20, disclosures in Wieczorek and Wolf, and the declaration testimony of Dr. Blalock. Pet. 58–71. Patent Owner does not contend that the limitations in claims 2, 4–9, 13–19, 21, 22, 24–27, and 31–36 are absent in the combination of Wieczorek and Wolf, and therefore, has waived such arguments. *See, e.g., In re NuVasive*, 842 F.3d at 1379–82; *see generally* PO Resp.; PO Sur-reply. As discussed above, we are persuaded that the cited evidence sufficiently supports Petitioner's contentions that independent claims 1 and 20 would have been unpatentable as obvious over the combination of Wieczorek and Wolf, and also are persuaded that the cited evidence sufficiently shows claims 2, 4–9, 13–19, 21, 22, 24–27, and 31–36 likewise obvious. For the same reasons provided above for independent claims 1 and 20, and the reasons set forth in the Petition (Pet. 58–71), and notwithstanding Patent Owner's proffered objective indicia of nonobviousness discussed above, we conclude that

Petitioner has demonstrated by a preponderance of the evidence that dependent claims 2, 4–9, 13–19, 21, 22, 24–27, and 31–36 would have been unpatentable as obvious over the combination of Wieczorek and Wolf.

*G. Additional Challenges Applying Gupta*<sup>24</sup>

Patent Owner does not specifically discuss the third and fourth challenges applying Gupta beyond arguing that the Petition does not rely upon Gupta to cure the deficiencies argued above with respect to Kawagoe. *See e.g.*, PO Resp. 30, 35, 37.

With respect to these challenges, Petitioner contends that “[s]everal claim elements of the Challenged Claims recite ‘transistors’ or ‘devices.’” Pet. 71. Petitioner further contends that “[a]s discussed under Grounds I-II, Patent Owner interprets these elements as requiring one or more transistors, and not a plurality of transistors.” *Id.* (citing Pet. §§ VII.A.1.c–d, VII.B.1.c–d). According to Petitioner, “[g]rounds III-IV mirror Grounds I-II, respectively, except Gupta is explicitly combined with Kawagoe (Ground I) or with Wieczorek-Wolf (Ground II) to render obvious elements under an interpretation of ‘transistors’ or ‘devices’ requiring a plurality of such devices.” *Id.* (citing Ex.1003 ¶¶ 182–190).

According to Petitioner, “Gupta is directed to ‘automatically producing layouts for CMOS circuits,’” and “explains that good circuit layout practice dictates forming as many transistors in the same active region through diffusion abutment as possible to minimize area-wasting diffusion gaps.” Pet. 71–72 (quoting Ex. 1014, 1:7–10, 1:28–31) (citing Ex. 1014,

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<sup>24</sup> Petitioner refers to these challenges as ground III and ground IV. Pet. 6.

1:52–54, 2:17–21). According to Petitioner, “Gupta describes several techniques to achieve optimal layout, such as transistor folding and chaining.” *Id.* at 72 (citing Ex. 1014, 1:49–2:24, 3:64–4:1, Figs. 2, 3). In Petitioner’s annotated version of Gupta’s Figure 4, “transistor gates and metal contacts that overlay the active regions are colored red and blue, respectively” and “illustrates *six* chained PMOS transistors formed in a p-channel active region (green) and *three* chained NMOS transistors formed in an n-channel active region (purple).” *Id.* (citing Ex. 1014, 4:12–43, Ex. 1003 ¶ 184); *see id.* at 73 (citing Ex. 1003 ¶ 185; Ex. 1015, 6:17–29, Figs. 1, 2; Ex. 1025, 48).

As rationale for combining, Petitioner contends:

A POSITA would have been motivated to fabricate a CMOS chip according to the combined teachings of Kawagoe and Gupta (and likewise, of Wieczorek-Wolf and Gupta) to achieve high packing density (taught by Gupta) at submicron dimensions (for which a twin-well CMOS process of the type taught in Kawagoe and Wieczorek-Wolf was known to be the technology of choice). The combinations gain the additional benefit of improved immunity to soft errors through appropriate well doping.

Pet. 74 (citing Ex. 1008B, 373, 388; Ex. 1003 ¶¶ 186, 187; Ex. 1007, 15:62–16:11). Petitioner contends that combining Gupta with Kawagoe and combining Gupta with Wieczorek and Wolf “merely amounts to” use of a known technique to improve similar devices in the same way and combining prior art elements according to known methods. *Id.* at 74 (citing Ex. 1003 ¶ 187).

Petitioner also contends that “[t]here is reasonable expectation of success with predictable results because Kawagoe’s and Wieczorek’s CMOS fabrication process would be used for their intended purpose of fabricating

CMOS circuits according to known CMOS layouts generated by Gupta, also for its intended purpose.” Pet. 74–75 (citing Ex. 1003 ¶ 187). Further, Petitioner contends that “Gupta’s optimal circuit layout is process-agnostic and applies to the layout of *any* CMOS semiconductor chip, including the layout of CMOS chips fabricated according to the teachings of Kawagoe and/or Wieczorek-Wolf. *Id.* at 75 (citing Ex. 1003 ¶ 187).

Based on Petitioner’s persuasive contentions and evidence, we determine that Petitioner sufficiently establishes that a person of ordinary skill in the art would have had a rational reason to combine the teachings of Kawagoe with those of Gupta with a reasonable expectation of success. We have reviewed the cited teachings of Kawagoe and Gupta and the supporting testimony of Dr. Blalock, and we determine that Petitioner establishes by a preponderance of the evidence that the subject matter of claims 1–9, 13, 14, 16–27, and 31–36 would have been obvious over the combination of Kawagoe and Gupta, notwithstanding Patent Owner’s proffered objective indicia of nonobviousness discussed above.

Further, based on Petitioner’s persuasive contentions and evidence, we determine that Petitioner sufficiently establishes that a person of ordinary skill in the art would have had a rational reason to combine the teachings of Wieczorek and Wolf with those of Gupta with a reasonable expectation of success. We have reviewed the cited teachings of Wieczorek, Wolf, and Gupta and the supporting testimony of Dr. Blalock, and we determine that Petitioner establishes, by a preponderance of the evidence, that the subject matter of claims 1, 2, 4–9, 13–22, 24–27, and 31–36 would have been obvious over the combination of Wieczorek, Wolf, and Gupta,

notwithstanding Patent Owner's proffered objective indicia of nonobviousness discussed above.

*H. Additional Challenges Applying Silverbrook*<sup>25</sup>

Patent Owner does not specifically discuss the fifth and sixth challenges applying Silverbrook beyond arguing that the Petition does not rely upon Silverbrook to cure the deficiencies argued above with respect to Kawagoe. *See e.g.*, PO Resp. 30, 35, 37.

Petitioner contends that claims 19 and 36 recite “[t]he semiconductor device of claim [1/20], wherein the device is an image sensor.” Pet. 76 (alterations by Petitioner). According to Petitioner, “[a]s discussed under Grounds I-II, it would have been obvious to a POSITA to implement either the CMOS designs in Kawagoe or in Wieczorek-Wolf in an image sensor.” *Id.* (citing Pet. §§ VII.A.15, VII.B.15). Petitioner further contends that “Grounds V-VI mirror Grounds I-II, respectively, except that Silverbrook is explicitly combined with Kawagoe of Ground I or Wieczorek-Wolf of Ground II to render obvious the implementation of the disclosed design in an image sensor.” *Id.*

According to Petitioner:

Both Kawagoe and Wieczorek-Wolf expressly disclose CMOS designs and Silverbrook discloses use of a “CMOS image sensor.” Because Silverbrook calls for a “CMOS” image sensor, but does not include any details about the fabrication of CMOS devices, a POSITA would have been motivated to implement the CMOS device designs disclosed by Kawagoe and Wieczorek-Wolf, respectively. Indeed, Silverbrook expressly seeks incorporation of existing CMOS designs into its image sensor

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<sup>25</sup> Petitioner refers to these challenges as ground V and ground VI. Pet. 6.

device, highlighting that “[t]he CPU, DRAM, Image Sensor, ROM, Flash memory . . . can be vendor supplied cores.” Using the CMOS device designs from Kawagoe and Wieczorek-Wolf in the CMOS image sensor from Silverbrook would have been nothing more than the “combination of familiar elements according to known methods [. . .] yield[ing] predictable results.” Accordingly, a POSITA would also have a reasonable expectation of success in combining the CMOS designs from Kawagoe and Wieczorek-Wolf with Silverbrook’s CMOS image sensor.

Pet. 76–77 (citing Ex. 1006 ¶¶ 7–14; Ex. 1042, 6:41–67, 7:28–30; Ex. 1044, 1, Fig. 2; Ex. 1003 ¶¶ 191, 192; *KSR*, 550 U.S. at 416).

Based on Petitioner’s persuasive contentions and evidence, we determine that Petitioner sufficiently establishes that a person of ordinary skill in the art would have had a rational reason to combine the teachings of Kawagoe with those of Silverbrook as well as combine the teachings of Wieczorek and Wolf with those of Silverbrook with a reasonable expectation of success. We have reviewed the cited teachings of Kawagoe, Wieczorek, Wolf, and Silverbrook and the supporting testimony of Dr. Blalock, and we determine that Petitioner establishes, by a preponderance of the evidence, that the subject matter of claims 19 and 36 would have been obvious over the combination of Kawagoe and Silverbrook, and would have been obvious over the combination of Wieczorek, Wolf, and Silverbrook, notwithstanding Patent Owner’s proffered objective indicia of nonobviousness discussed above.

### *I. Constitutionality of AIA*

In less than two pages, Patent Owner argues “[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. *Cf.* 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 reasons discussed above, we are persuaded that the Petition is not time-barred under 35 U.S.C. § 315(b) and that Petitioner has met its burden to show, by a preponderance of the evidence, that all of the Challenged Claims (i.e., claims 1–9, 13–27, and 31–36) are unpatentable under 35 U.S.C. § 103.<sup>26</sup> Our conclusions are summarized in the following table.

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<sup>26</sup> Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

<b>Claim(s)</b>	<b>35 U.S.C. §</b>	<b>Reference(s)/ Basis</b>	<b>Claim(s) Shown Unpatentable</b>	<b>Claim(s) Not Shown Unpatentable</b>
1-9, 13, 14, 16-27, 31-36	103(a)	Kawagoe	1-9, 13, 14, 16-27, 31-36	
1, 2, 4-9, 13-22, 24-27, 31-36	103(a)	Wieczorek, Wolf	1, 2, 4-9, 13-22, 24-27, 31-36	
1-9, 13, 14, 16-27, 31-36	103(a)	Kawagoe, Gupta	1-9, 13, 14, 16-27, 31-36	
1, 2, 4-9, 13-22, 24-27, 31-36	103(a)	Wieczorek, Wolf, Gupta	1, 2, 4-9, 13-22, 24-27, 31-36	
19, 36	103(a)	Kawagoe, Silverbrook	19, 36	
19, 36	103(a)	Wieczorek, Wolf, Silverbrook	19, 36	
<b>Overall Outcome</b>			1-9, 13-27, 31-36	

## VI. ORDER

For the foregoing reasons, it is:

ORDERED that Petitioner demonstrates, by a preponderance of the evidence, that each of the challenged claims 1-9, 13-27, and 31-36 of the '481 patent is unpatentable as obvious under 35 U.S.C. § 103(a);

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

FURTHER ORDERED that, after conferring, the parties shall, within ten days of this Decision, jointly submit to the Board via email to

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Trials@uspto.gov, a version of this Decision to be filed in the public record, with any redactions proposed by either party; and

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

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