

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INERGY TECHNOLOGY, INC.,
Petitioner

v.

FORCE MOS TECHNOLOGY CO. LTD.,
Patent Owner

Inter Partes Review No. IPR2024-00093
U.S. Patent No. 7,629,634

PATENT OWNER'S SURREPLY TO PETITIONER'S REPLY

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Patent Owner's Exhibit List

Exhibit No.	Description
2001	Transcript of Feb. 13, 2024 Deposition of David Kuan-Yu Liu, PhD in <i>Force MOS Technology Co., Ltd. v. ASUSTeK Computer, Inc.</i> , Case No. 2:22-cv-00460-JRG (E.D. Tex.)
2002	Declaration of David Kuan-Yu Liu, Ph.D., served on Jan. 30, 2024 in <i>Force MOS Technology Co., Ltd. v. ASUSTeK Computer, Inc.</i> , Case No. 2:22-cv-00460-JRG (E.D. Tex.)
2003	Defendant ASUSTeK Computer, Inc.'s Motion to Stay Pending Resolution of Inter Partes Reviews, filed on Nov. 30, 2023 as Dkt. No. 30 in <i>Force MOS Technology Co., Ltd. v. ASUSTeK Computer, Inc.</i> , Case No. 2:22-cv-00460-JRG (E.D. Tex.)
2004	Amended Docket Control Order, filed on Jan. 18, 2024 as Dkt. No. 35 in <i>Force MOS Technology Co., Ltd. v. ASUSTeK Computer, Inc.</i> , Case No. 2:22-cv-00460-JRG (E.D. Tex.)
2005	Cover pleading to Defendant ASUSTeK Computer, Inc.'s Invalidity Contentions, served on Jul. 18, 2024 in <i>Force MOS Technology Co., Ltd. v. ASUSTeK Computer, Inc.</i> , Case No. 2:22-cv-00460-JRG (E.D. Tex.)
2006	Excerpts from S. Gibilisco, Illustrated Dictionary of Electronics (2001) for "layer"
2007	Excerpts from J. Ruzyllo, Semiconductor Glossary (2d Ed. 2017) for "doping by ion implantation," "doping during material growth," "ion implantation"
2008	U.S. Patent No. 6,888,196 to Kobayashi
2009	Claim Construction Declaration of Dean Neikirk, Ph.D. (Corrected), as filed as Exhibit D to Dkt. No. 74 in <i>Alpha and Omega Semiconductor Limited, et al. v. Force MOS Technology Co. Ltd.</i> , Civ. No. 5:22-cv-05448 (N.D. Cal.)

Exhibit No.	Description
2010	Memorandum Order and Opinion (regarding claim construction), Dkt. No. 94 from <i>Alpha and Omega Semiconductor Limited et al v. Force MOS Technology Co., Ltd.</i> , Case No. 5:22-cv-05448-PCP (N.D. Cal.)
2011	Claim Construction Order, Dkt. No. 132 from <i>Force MOS Technology Co., Ltd. v. ASUSTeK Computer, Inc.</i> , Case No. 2:22-cv-00460-JRG (E.D. Tex.)
2012	Declaration of Dean Neikirk, Ph.D. in Support of Patent Owner's Response
2013	Curriculum Vitae of Dean Neikirk, Ph.D.
2014	Transcript of Aug. 22, 2024 Deposition of David Kuan-Yu Liu
2015	Zhang, Ruizhe, and Yuhao Zhang. "Power device breakdown mechanism and characterization: Review and perspective." Japanese Journal of Applied Physics 62.SC (2023): SC0806
2016	Additional Excerpts from Semiconductor Glossary
2017	Search results from scholar.google.com for article search “‘lateral contact layer’ MOSFET”
2018	Wang, Jingshan. High-Power Vertical GaN Electronic Devices Formed by Epitaxial Lift-Off. Diss. University of Notre Dame, 2018.
2019	Definition of “lateral” from https://www.merriam-webster.com/dictionary/lateral
2020	--Intentionally Not Used--
2021	Definition of “contact” from https://www.merriam-webster.com/dictionary/contact
2022	Definition of “contact” from https://www.lamresearch.com/technical-glossary/

Exhibit No.	Description
2023	Definition of “layer” from https://www.merriam-webster.com/dictionary/layer
2024	U.S. Patent No. 3,025,589 to Hoerni, “Method of manufacturing semiconductor devices”
2025	Definition of “layer” from https://dictionary.cambridge.org/us/dictionary/english/layer
2026	Suzuki, Kunihiro, A. Satoh, and T. Sugii. "Counter doping into uniformly and heavily doped channel region of sub-0.1 μm SOI MOSFETs." IEEE Electron Device Letters 17.1 (1996)
2027	U.S. Patent No. 4,315,781 to Henderson, “Method of controlling MOSFET threshold voltage with self-aligned channel stop”
2028	U.S. Patent No. 8,884,409 to Wong, “Wafer backside doping for thermal neutron shielding”
2029	Definition of “cover” from https://www.merriam-webster.com/dictionary/cover
2030	Excerpts of Sedra, Adel S., Microelectronic Circuits (5 th Ed. 2004)
2031	Excerpts of Williams, Principles and Elements of Power Electronics, ISBN 978-0-9553384-0-3 (2006)
2032	Sharma, R. S., and M. A. Peer. "Some Features of Avalanche Breakdown Phenomena Part 1: Transistors and Diodes." IETE Journal of Research 27.5 (1981): 178-184
2033	U.S. Patent No. 6,084,264 to Darwish, “Trench MOSFET having improved breakdown and on-resistance characteristics”
2034	U.S. Patent No. 6,545,315 to Hshieh et al., “Trench DMOS transistor having reduced punch-through”

I. INTRODUCTION

In contrast to the conclusory expert analysis accompanying the Petition, the Patent Owner Response (Paper No. 25, hereinafter “POR”) was accompanied by a detailed, evidence-based expert analysis and explanation as to why each of Petitioner’s grounds failed. In its Reply (Paper No. 27), Petitioner offers no new expert testimony, and instead, relies on attorney argument alone to attempt to address the deficiencies identified by the POR.

In particular, the POR presented detailed expert testimony that each of the cited prior art fails to disclose limitation 1[a]. The POR also showed that Shiraishi (and thus the proposed Kobayashi-Shiraishi combination) failed to satisfy Petitioner’s own construction requiring the lateral contact layer of limitation 1[g] to cover the “entire” sidewalls of the source contact trenches. Petitioner’s reply to these points presents only conclusory attorney argument that plainly contradicts the references’ disclosures.

In addition, the POR presented detailed expert testimony in support of Patent Owner’s construction of “lateral contact layer” and explained why the prior art fails to satisfy that construction. Petitioner’s claim construction arguments in reply merely repeat the reasoning from the Board’s institution decision without substantively engaging with Patent Owner’s arguments. And Petitioner’s arguments

that the references satisfy Patent Owner's construction simply disregard what that construction actually requires.

Furthermore, the POR also showed that, even if Patent Owner's construction of "lateral contact layer" were rejected, the prior art would still fail to satisfy the ordinary meaning of "covered by a lateral contact layer." As to Hirler, Petitioner's reply simply mischaracterizes Patent Owner's argument. As to Shiraishi, Petitioner has no response at all.

In short, Patent Owner's arguments are supported by detailed factual analysis and expert testimony, while Petitioner's arguments are conclusory and supported by attorney argument. The Board should hold each challenged claim patentable.

II. CLAIM CONSTRUCTION

A. "lateral contact layer"

Patent Owner submitted detailed expert testimony explaining why "lateral contact layer" lacks any established meaning and thus is a coined term whose meaning can only be determined from the specification. POR, 10-11. In Reply, Petitioner cites the statement in *Malvern Panalytical Inc. v. TA Instruments-Waters LLC*, 85 F.4th 1365, 1374 (Fed. Cir. 2023) that the coined term doctrine is not applicable where a phrase can be understood from the plain meaning of its individual terms. Reply, 2-3. But, Petitioner submits no evidence of the meaning of the

individual terms in the field, which would be required to rely on that doctrine. *See Ruckus Wireless v. Innovative Wireless*, 824 F. 3d 999, 1003-04 (Fed. Cir. 2016).

Moreover, the POR specifically showed—supported by expert analysis of the claims—that the phrase cannot be understood by simply looking at its individual terms due to potential ambiguities if one did not consider the specification. POR, 11-13.¹ Petitioner’s Reply contains no substantive response, and instead argues that it is “irrelevant” whether there are potential ambiguities in the claim text outside the context of the specification. Reply, 2-3. But looking at the claim words individually outside of the context of the specification is exactly the approach Petitioner advocates in its reliance on *Malvern*.

Moreover, as discussed, *Phillips* held that “the specification is ‘the single best guide to the meaning of a disputed term,’” and specifically endorsed reliance use of the specification to identify *implicit* definitions. *Phillips v. AWH Corp.*, 415 F. 3d 1303, 1321 (Fed. Cir. 2005) (en banc). And, as noted in the POR—and ignored by Petitioner—the POR demonstrates that the specification does clearly manifest definitional intent via the use of “present invention.” POR, 15-16.

¹ Patent Owner provided that analysis—which is unrebutted—specifically because the Board’s institution decision “discern[ed] no ambiguity in [the] term on [the] record.” Paper No. 13 at 9.

1. “lateral contact layer” requires P* doping

In the POR, Patent Owner demonstrated that the specification clearly defined lateral contact layer as having P* doping (or N* doping for P-Channel MOSFETs) by using the phrase “the present invention,” which creates a strong presumption of definitional intent.² POR, 16 (citing Ex. 1001, 2:1-11). Petitioner wholly fails to respond to that argument (Reply, 2-4), and thus any argument to the contrary by Petitioner has been forfeited.

Petitioner does repeat the claim differentiation argument that the Board raised in its decision on institution. Reply, 5 (citing Paper 13, 11-12). But, the POR already demonstrated that “claim differentiation is a rebuttable presumption that may be overcome by a contrary construction dictated by the written description or prosecution history.” POR, 17. And here, using “the present invention” to define “lateral contact layer” as having P* doping plainly overcomes any potential presumption from claim differentiation. Petitioner responds that “Patent Owner’s argument that the restriction on dopant concentration in its construction does not

² Petitioner suggests that the construction’s recitation of both P* and N* doping somehow demonstrates that the specification does not provide definitional language. But that simply reflects the express teaching in the specification that the “invention is also applicable to a P-channel MOSFET structure” “by inverting the conductive type.” *Id.*, 2:16-19, 4:47-50.

render claims 2 and 6 redundant misses the point.” Reply, 6. To the contrary, Petitioner misunderstands the law—Federal Circuit precedent is clear that any presumption from claim differentiation is weak—and easily overcome—when the proposed construction would not render a dependent claim otherwise “identical in scope” as a claim from which it depends. POR, 18 (*citing Apple, Inc. v. Ameranth, Inc.*, 842 F.3d 1229, 1238 (Fed. Cir. 2016)). The POR also showed that claims 2 and 6 would not be rendered identical to claim 1 by Patent Owner’s proposed construction because claim 2 narrows the MOSFET of claim 1 to only N-Channel MOSFETs and claim 6 narrows the MOSFET of claim 1 to only P-Channel MOSFETs, whereas Patent Owner’s construction would expressly permit either N or P-channel MOSFETs. POR, 18-19. Petitioner fails to dispute those facts.

2. “lateral contact layer” requires implantation into the sidewalls of an existent source contact trench

As discussed, the *Phillips* claim construction standard that this Board is required to apply permits *implicit* definitions of claim terms. 415 F. 3d at 1321-1322 (holding that the “specification may define claim terms by implication” and that a “claim term may be clearly redefined without an explicit statement of redefinition.” (citations omitted)). Applying that standard, Patent Owner and its expert provided a detailed analysis explaining why the disclosures of the specification of the ’634 Patent clearly require dopant implant into existing sidewalls. POR, 19-21. In reply,

Petitioner dismisses all of that evidence as not “clearly defined” and cites *In Re Hiniker Co.* Reply, 7. But that is pre-*Phillips* case law arising from an *ex parte* reexamination applying the ‘broadest reasonable interpretation standard.’” 150 F.3d 1362, 1368 (Fed. Cir. 1998). Adopting Petitioners’ arguments—which ignore the specification and apply *In Re Hiniker Co.* rather than *Phillips*—would be legal error. 37 C.F.R. § 42.100(b).

The POR also showed that the claim’s choice of “layer” versus “region” for different structures indicates that “lateral contact layer” is different than a generic region—instead indicating a thin sheet, like that formed from ion injection into trench sidewall. POR, 20.³ In Reply, Petitioner argues that “Patent owner undermines its own purported distinction between ‘layer’ and ‘region’ by construing ‘lateral contact layer’ to mean ‘a region of dopant which is implanted into sidewalls of the source contact trenches.’” Reply, 8. But, Petitioner misses the point—a “layer,” which connotes a thin sheet, is narrower than a generic *region*. Patent Owner’s proposed construction respects *that* distinction and the claim’s choice of

³ Petitioner notes a doped region can be created by means other than ion implantation. Reply at 7. But, Petitioner cites to no evidence that a *thinly* doped region can be created *on the sidewalls of a trench* by means other than ion implantation. Nor does it present any evidence or argument that the alleged “lateral contact layer” in Hirler or Shiraishi is a thin sheet along the sidewalls.

the term “layer” in “lateral contact layer.” The construction expressly narrows the term “region” by requiring it to be created by ion implantation into existing sidewalls, a process which would create a thin sheet. POR, 19-21; Ex. 2012, ¶120.

B. “the sidewalls of said trenches in said base layer are covered”

Petitioner admits that “the entire sidewalls of the said trenches in said base layer”—which Petitioner itself proposed—is a correct construction of this term. Reply, 8. However, Petitioner now argues that an express construction is unnecessary. *Id.*, 9.⁴ Petitioner’s suggestion to avoid an express construction is clear invitation to legal error. The POR applied Petitioner’s proposed construction requiring coverage of the *entire* sidewalls in the base layer in its arguments regarding Shiraishi. POR, 42. Indeed, this is required because the law requires that the *properly construed claim* be compared to the prior art. *Zenith Electronics v. PDI Communication Systems*, 522 F. 3d 1348, 1363 (Fed. Cir. 2005). Allowing Petitioner to avoid the consequences of its own proposed construction at this late stage in the proceedings would violate the applicable procedural rules for an IPR, as

⁴ Petitioner suggests it improper that the POR stated a construction was needed after institution, but the POPR did not. But POPRs and PORs are different papers, filed in different procedural circumstances, for different purposes. *Compare* 37 C.F.R. § 42.107(a) *with* § 42.120.

well as Patent Owner's due process rights. *See, e.g.*, 37 CFR § 42.23(b); 37 CFR § 42.104(b)(3); 35 U.S.C. § 312(a)(3).

III. PETITIONER HAS FAILED TO DEMONSTRATE THAT ANY CHALLENGED CLAIM IS UNPATENTABLE⁵

A. Grounds 1-2: Hirler Fails to Invalidate the Challenged Claims

1. Claim 1

(a) 1[a]: Hirler Fails to Disclose an “*epitaxial* layer corresponding to said drain region”

The POR demonstrated that there is no evidence that Hirler's n- drift zone 11 is an *epitaxial* layer, and thus each of Petitioner's grounds based on Hirler fail. POR, 9. In reply, Patent Owner argues that the “n- drift zone 11” is, in fact, an epitaxial layer because claim 1 of Hirler states that the various layers are “successively provided.” Reply, 10 (citing Ex. 1006, cl. 1).

This argument suffers from several fatal problems. First of all, neither claim 1 of Hirler nor the language of “successively provided” was cited in the Petition or Petitioner's expert's declaration in regards to limitation 1[a]. Pet., 23-24; Ex. 1003, ¶¶65-66. Accordingly, such argument is forfeited and improper to raise for the first time in Petitioner's reply. *See Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016).

⁵ Because a surreply is optional, Patent Owner does not address all of the arguments made in the POR. However, all such arguments are expressly preserved.

Second, Petitioner's argument is based purely on attorney argument. It submits no expert analysis that would explain why "successively provided" means that "n- drift zone 11" is an epitaxial layer.

Third, as noted in the POR—and undisputed by Petitioner—epitaxial layer means a layer created by *epitaxis*, a specific process where a thin layer of single crystal material is deposited on single-crystal substrate. POR, 22-23; Reply, 10. However, Petitioner presents no evidence or argument explaining why the language "successively provided" necessarily means "thin layer" or "single crystal material" or "deposited on single-crystal substrate." None of those terms (or anything like them) appear in Hirler's claim 1, and Petitioner presents no argument why they inexorably flow from the language "successively provided."

Indeed, Hirler's claim 1 is not a process claim—it is an apparatus claim. Ex. 1006, cl. 1 ("A MOS power transistor arrangement having a vertical transistor structure in which ..."). Thus, there is no reason to believe that the language "successively provided" in Hirler's claim 1 provides any indication as to how the MOSFET was made. Rather, it simply describes a vertical ordering of the zones as arranged in the final product (substrate on bottom, drift zone on top of substrate, body zone on top of drift zone, and source zone on top of body zone).

Moreover, although it was (and remains) Petitioner's burden to set forth an inherency theory in the Petition, Patent Owner nonetheless rebutted any such

argument. In particular, the POR demonstrated that there are alternative ways for creating the n- drift zone (11) in Hirler other than through epitaxy, including back-side doping and counter-doping. POR, 25. Again, these arguments were supported by expert testimony, including the testimony of Petitioner’s own expert. Ex. 2012, ¶¶113-114; Ex. 2014, 166:15-8, 167:24-169:15. Petitioner once again only responds with attorney argument. In particular, it notes that “counter-doping and back-side doping are both processes that introduce dopants into a substrate” and contrasts this with Hirler’s claim 1 which Petitioner’s contends discloses they “are disposed on top of each other in a specific order.” Reply, 11. But, as noted, Hirler’s claim 1 merely recites a physical arrangement of zones within a final product—it says nothing about how those zones are created, and thus does nothing to foreclose the n- drift zone 11 being created by counter-doping or back-side doping into or through a substrate.

Finally, Petitioner’s statement that “[t]he only way to provide Hirler’s drift zone on the substrate is via epitaxial growth” (Reply, 11) is clearly improper because it is wholly unsupported by expert analysis (or any other factual basis) and because it is an inherency argument that should have appeared in the Petition—not the Reply.

(b) 1[g]: Hirler Fails to Disclose “the sidewalls of said trenches in said base layer are covered by the lateral contact layer”

(1) Hirler’s “body amplification zone” is not a “lateral contact layer” as properly construed because it is not implanted into the sidewalls

The POR demonstrated that, contrary to Patent Owner’s construction of “lateral contact layer,” Hirler’s body amplification zone is created by implantation through the source layer, before the source contact trench (and its sidewalls) have even been etched. POR, 28. In its Reply, Petitioner does not substantively dispute these facts, nor that Hirler does not satisfy Patent Owner’s proposed construction.

Instead, Petitioner raises claim construction arguments again. In particular, it argues that the claim cannot be construed to require a method step in an apparatus claim, and thus ion implantation into the sidewalls is not required. Reply, 12. However, Patent Owner showed—and Petitioner presents no rebuttal—that these differences are *structural* and not simply non-structural process steps. POR, 29-30; Ex. 2012, ¶122. Indeed, sometimes the nature of a claim term itself requires some aspects of process be reflected in a structural term’s construction because the meaning of that term invokes a particular process step. *See, e.g., Hazani v. United States Int’l Trade Comm’n*, 126 F.3d 1473, 1479 (Fed.Cir.1997) (holding that “chemically engraved” is structural limitation, despite having aspects of a process e.g., “asperities of the sort produced by oxidation”); *In re Garnero*, 412 F.2d 276,

279 (C.C.P.A. 1969) (holding that “interbonded one to another by interfusion” is a structural limitation, despite indicating a particular process, similar to “intermixed,” “ground in place,” “press fitted,” “etched,” and “welded”). Thus, recognizing that “lateral contact layer” is a structural term that nonetheless invokes the process of ion implantation is entirely proper. As discussed above (*Supra*, II.A.2) and in the POR, the specification of the ’634 Patent implicitly defines “lateral contact layer” to require ion implantation into the sidewalls of a source contact trench.

(2) Hirler’s “body amplification zone (19)” fails to satisfy the ordinary meaning of “covered by the lateral contact layer”

The POR also demonstrated that, if the Board rejects Patent Owner’s proposed construction of “lateral contact layer,” Hirler fails to satisfy that limitation under its ordinary meaning. In particular, Hirler discloses that its “body amplification zones” (resulting from ion implantation through the source layer prior to contact trench etching) are broad implantation regions that extend to nearly reach the gate trenches. POR, 28-29. By contrast the phrase “covered by the lateral contact layer” would be understood by a POSITA as being consistent with a thin sheet spread over the sidewalls of the source contact trench. *Id.* In Reply, Petitioner provides no evidence or analysis to the contrary. Instead, it simply states that “even under the purported plain and ordinary meaning, Patent Owner still tries to import a method step into apparatus claim 1.” Reply, 13. But whether or not a doped region is thin or broad

is structural, not a method step. Thus, Petitioner presents no argument or evidence disputing that Hirler fails to satisfy the ordinary meaning of “lateral contact layer.”

(3) Hirler’s “body amplification zone (19)” is not a “lateral contact layer” as properly construed because it does not have P* doping

The POR demonstrated that Hirler does not have “P*” doping because Hirler’s body amplification zones instead have P+ doping, and P+ is plainly not “between P and P+ (P* doping).” POR, 30. In Reply, Petitioner argues that Hirler’s disclosure that its P+ body amplification zone has doping between the “P” base and “P++” base contact layer satisfies the construction. Reply, 13. In particular, citing its expert’s conclusory deposition testimony, Petitioner argues that “P* is not a term of art and only denotes a relative doping concentration between that of the base contact layer and the base layer.” *Id.*

The Board should disregard that testimony, which is unsupported and contradicts the prior unequivocal statements by Dr. Liu, who plainly changed his position after reading Patent Owner’s Preliminary Response. *See* Ex. 1003, ¶29 (“Doping concentration P* is doped more heavily than P but less than P+”); Ex. 2002, ¶47 (“Doping concentration P* is doped more heavily than P but less than P+”); *compare* Ex. 2001, 51:11-15 *with* Ex. 2014, 20:24-21:24 (changing answer regarding meaning of P+ doping from litigation to post-institution IPR deposition). It also contradicts Petitioner’s statements in the Petition itself. Pet., 7 (“P* is more

heavily doped than P and less than P⁺”). Petitioner provides no explanation for the clear change in position by it and its expert.

Furthermore, Petitioner’s argument fails because it mischaracterizes Patent Owner’s construction. Patent Owner’s claim construction does not mention the base layer or base contact layer. POR, 21. Indeed, Patent Owner expressly noted that, in discussing the claim differentiation issue relating to claim 2 and claim 6, that having doping between the base layer and the base contact layer is a limitation added in claims 2 and 6 and but *not* present in Patent Owner’s construction of “lateral contact layer.” POR, 18.

Moreover, Petitioner’s contention that P* simply means “between the doping concentration of a base contact layer and the doping concentration of a base layer” is contrary to the specification of the ’634 Patent—the primary source of Patent Owner’s proposed construction. Indeed, the specification is the most important place to look to determine the meaning of “P*” given that Petitioner’s expert admits that “P* is not a term in the art.” Ex. 2014, 16:12-13. And, the specification expressly identifies P* as having less doping than P⁺ doping. Ex. 1001, 2:5-10 (“lateral contact layer P* has less doping concentration than the P⁺ base contact layer”), 3:65-67 (“P*-type lateral contact layer (209) has less doping concentration than the P⁺-type base contact layer (208)”), 4:3-6 (“the implantation procedure of the P⁺-type base contact layer (208) has higher doping concentration of BF₂ (boron

fluoride) than the P*-type lateral contact layer (209).”). If the patentee had wanted P* to refer to any intermediate doping between that of the base contact layer and the base layer, it would not have repeatedly mentioned “P” and “P+”—those are established terms in the field of semiconductors to refer to particular ranges of doping concentrations. Ex. 2009, 13, n. 6; Ex. 2030, 3, n.1.

B. Grounds 3-4: Shiraishi Fails to Invalidate the Challenged Claims

1. Claim 1

a) 1[a]: Shiraishi Fails to Disclose the Specific Arrangement of Layers Recited in Limitation 1[a]

The POR demonstrated that Shiraishi fails to disclose the specific arrangement of layers recited in limitation 1[a], and in particular, “a source layer ... disposed on the top of said base layer,” because layer 14 interposes Shiraishi’s source layer and base layer. POR, 38.

Petitioner argues that Patent Owner did not understand “how Petitioner has applied claim 1 to Shiraishi.” Reply, 16-17. In particular, Petitioner argues that “Shiraishi discloses two p-type semiconductor regions 13 and 14, which together form a body region,” and that “region 15, which forms a source layer corresponding to a source region, disposed on the top of region 14, which is part of the region 13 that forms the base layer corresponding to the body region.” *Id.* As an initial matter, these new arguments should be rejected as inconsistent with the Petition, or at the very least, as demonstrating that the Petition did not comply with the requirement to

set forth the grounds with particularity. 35 U.S.C. § 312(a)(3). In particular, the Petition's text expressly equated layer 13 with a "body layer." Pet., 38. Although "body layer" is neither a term in the claim nor a term in Shiraishi, Patent Owner assumed that the reference to "body layer" was a typographical error intending to refer to "base layer," given that Petitioner's expert did refer to element 13 as the claimed "base layer." POR, 38; Pet., 38; Ex. 1003, ¶100. Moreover, although the Petition's annotated version of Shiraishi's Fig. 8 does mention "body region (13 and 14)," the entirety of the Petition's analysis of limitation 1[a] against Shiraishi contains no identification of the claimed "base layer." Pet., 37-38. However, Petitioner is now trying to rewrite "body layer (13)" (in the Petition) and "base layer (13)" (in its expert declaration) to "base layer (13 and 14)." This is plainly improper.

Moreover, the POR included detailed argument, supported by expert testimony, that "it would be inappropriate to include layer 14 as part of the body region or base layer." POR, 39-40. In particular, it explained that a "body" region is where the channel is present in the MOSFET's "ON" state, which Shiraishi only discloses as being performed by layer 13. *Id.*; Ex. 2012, ¶138. And, by contrast, layer 14 is identified in Shiraishi as a "punch-through stopper layer," not a base layer, body region, or channel region. *Id.* Petitioner's reply ignores these arguments.

Instead, Petitioner simply cites to Shiraishi's disclosure that "the localized formation of the p- type semiconductor region 14 may be implemented in the p-type

semiconductor region 13.” Reply, 17 (citing Ex. 1009, [0072] and [0092]). But, again, this is an improper new argument which should have been raised in the Petition’s analysis of limitation 1[a], and is solely unsupported attorney argument. Moreover, it is not a reasonable interpretation—Shiraishi does not state that layer 14 is a body region or base layer or part of a body region or base layer. Indeed, Shiraishi’s discussion of “localized formation” is in its discussion of Shiraishi’s *process* for manufacturing its MOSFET. In particular, it states that “p-type semiconductor region 14 *serving as the punch-through stopper* layer [] may be formed *after* the heat treatment for the formation of the p– type *semiconductor region 13*” and “[b]y so doing, time for heat treatment ... can be shortened, so that localized formation of the p-type semiconductor region 14 inside the p– type semiconductor region 13 becomes possible” Ex. 1009, [0072]; *see also id.*, [0092] (similarly discussing “localized formation” in contest with process steps relating to “heat treatment”). In particular, in Shiraishi’s manufacturing process, layer 13 is first created via ion implantation. Ex. 1009, [0073]; Ex. 2012, ¶150. Then layer 14 is created in an upper portion of what used to be layer 13 via an additional ion implantation over the same area but at a shallower depth. *Id.* The result is what is shown in Fig. 8 of Shiraishi—a distinct layer 14 between layer 13 and layer 15. POR, 38-40; Ex. 1009, Fig. 8.

But Shiraishi's manufacturing process steps are wholly immaterial to the relevant question: is Shiraishi's layer 14—as present in the final MOSFET—part of a “body region”/“base layer” as claimed, or would a POSITA instead consider it a separate layer? As shown in the POR, the answer to that question is clearly “no.” Only Shiraishi's layer 13 is properly considered part of the base layer / body region. POR, 44 (citing Ex. 2012, ¶143; Ex. 1009, [0081]).

Thus, Shiraishi lacks “a source layer corresponding to said source region disposed on the top of said base layer” as recited in limitation 1[a] because layer 14 interposes Shiraishi's base layer and source layer. POR, 38-39; Ex. 2012, ¶138; Ex. 1009, Fig. 8.

b) 1[g]: Shiraishi Fails to Disclose a “lateral contact layer” as Properly Construed

(1) Shiraishi's layer 14 does not cover the “entire” sidewalls of the source contact trench in said base layer

The POR showed, supported by detailed expert testimony, that Shiraishi's layer 14 does not satisfy Petitioner's own claim construction requiring that the lateral contact layer cover the “entire” source contact trench in the base layer. POR, 42-44; Pet., 17-19. Petitioner now asserts that both layers 13 and 14 of Shiraishi together comprise the claimed base layer and body region. Reply, 17-18. But, this is entirely fatal to Petitioner's argument that Shiraishi's layer 14 is the lateral contact layer, because nothing in Shiraishi depicts or describes layer 14 as covering the entire

sidewalls of the source contact trench in the base layer (i.e. the vertical extent of the sidewalls in both layers 13 and 14).

In its Reply, Petitioner argues that Fig. 8 of Shiraishi shows the “entire” coverage required by its own claim construction. Reply, 19-20. But Petitioner’s argument still fails because its own annotated figure fails to show what its claim construction requires: entire coverage of the sidewalls in the base layer by the lateral contact layer. In particular, in the below figure, purple is Shiraishi’s layer 14, and green is Shiraishi’s layer 13:



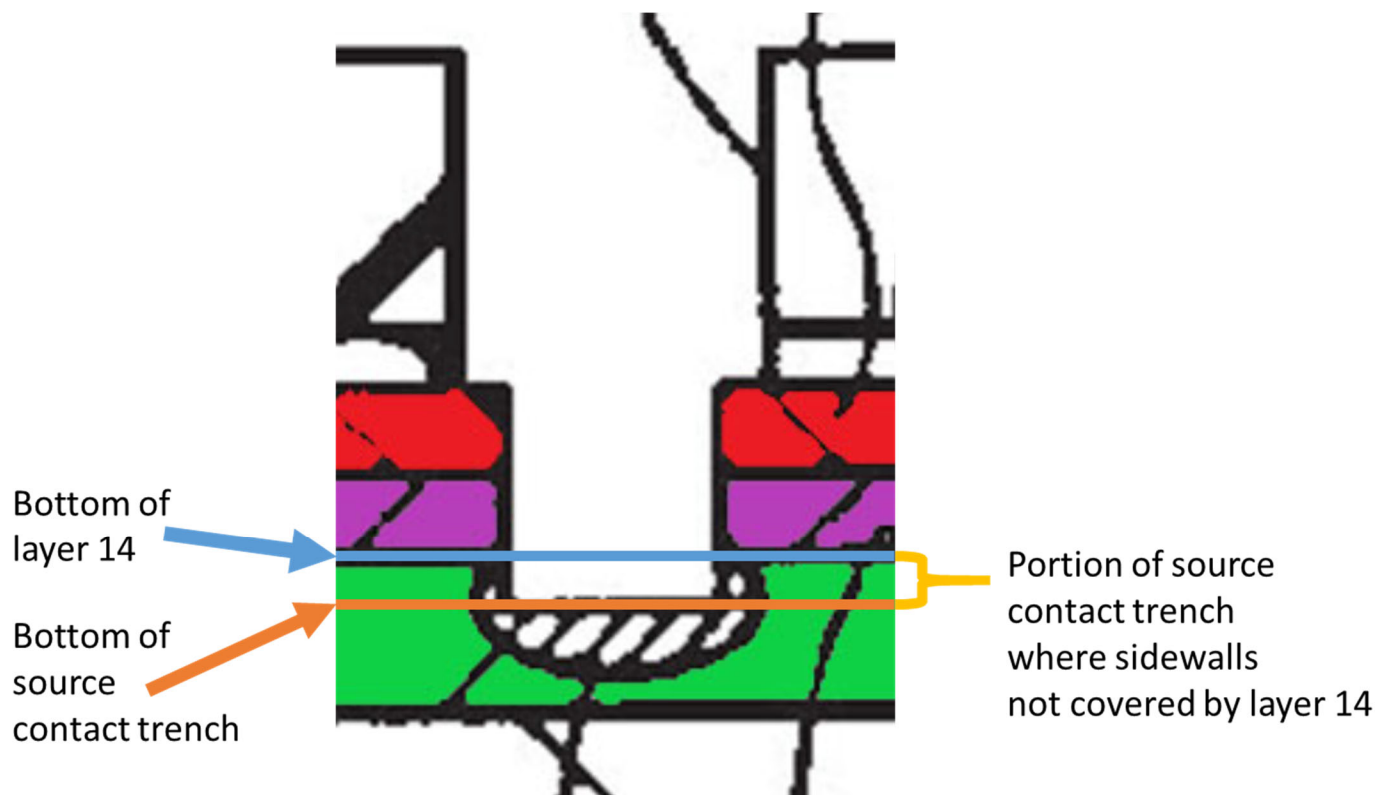
Reply, 19 (with Petitioner’s Annotations to Ex. 1009, Fig. 8).

As Petitioner’s own figure shows, the bottom of the source contact trench is *below* the bottom of Shiraishi’s layer 14 (purple). Thus, there are necessarily portions of the sidewalls in the source contact trench that are not covered by layer 14 (purple).

Petitioner ignores this deficiency in its argument, and instead argues that Patent Owner “improperly suggests that the base layer (green) covers the sidewall below the lateral contact layer (purple).” Pet., 18. But the relevant question is not whether the source contact trench sidewalls contact parts of the base layer other than layer 14 (i.e. whether green touches the sidewalls). Rather, the claim as Petitioner itself has construed it, requires that *only* layer 14 (purple) contact the sidewalls of the source contact trench “in the base layer.” Indeed, the term “in the base layer” plainly refers to the *vertical* extent of the base layer in the MOSFET (i.e. layers 13 and 14 of Shiraishi under Petitioner’s theory). POR, 42-43; Ex. 2012, ¶142; Pet., 5, 8 (annotating Fig. 2G to show base layer and lateral contact layer). Any interpretation of “in the base layer” as referring to where the base layer touches the source contact trench sidewalls would be nonsensical—the lateral contact layer is not described in the ’634 Patent as being part of its base layer, and thus such an interpretation of would exclude the preferred embodiment. *See, e.g.*, Ex. 1001, 4:53-5:16, Fig. 2G.

Thus, in Petitioner’s theory—where layers 13 and 14 together comprise the base layer—the sidewalls of the source contact trench “in the base layer” are the portions of the sidewalls that are present in the vertical extent between the top of layer 14 (purple) and the bottom of layer 13 (green). POR, 42-43; Ex. 2012, ¶142. As shown, Shiraishi’s Fig. 8 plainly shows portions of the trench extending below

the bottom of layer 14 (i.e. between the blue and orange lines in the below annotation), and thus cannot satisfy the limitation.



Reply, 19 (with further annotations to Petitioner’s annotations to Ex. 1009, Fig. 8).

Indeed, under Petitioner’s construction (which is based on the prosecution history), it is immaterial *what* covers the sidewalls of the source contact trench in the base layer if it is not the lateral contact layer. Pet., 17-19.

Ignoring its own construction, Petitioner compares Shiraishi to the disclosures of the ’634 Patent. Reply, 19-20. However, unlike Shiraishi, Fig. 2G of the ’634 Patent *does* illustrate the entire sidewalls of the source contact trench being covered by the lateral contact layer—the bottom of lateral contact layer 209

is plainly depicted as below the bottom of contact metal plugs 211. Ex. 1001, Fig. 2G.

(2) Shiraishi's layer 14 is not a "lateral contact layer" as properly construed because it is not implanted into sidewalls

The POR demonstrated that Shiraishi plainly does not satisfy Patent Owner's construction because layer 14 is created by implantation through the source layer, before the source contact trench (and its sidewalls) have even been etched. POR, 45-47. In its Reply, Petitioner does not substantively dispute these facts, or that Shiraishi does not satisfy Patent Owner's proposed construction. Reply, 20. Instead, Petitioner repeats its claim construction argument regarding "improperly import[ing] a method limitation. This fails for the same reasons discussed with respect to Hirler in Ground 1. *Supra*, III.A.1.b.1.⁶

⁶ Petitioner also includes the curious footnote contending that "[a]s explained with respect claim 1, Ground 1, this theory rests on a novel interpretation of "lateral contact layer" that is narrower than the construction initially proposed by Patent Owner." Reply at 20, n.1. But Petitioner's Reply in Ground 1, claim 1 makes no such argument. Reply at 10-11. Moreover, Patent Owner has consistently taken the position that the claim should be construed to require ion implantation *into* already existent sidewalls. See Paper No. 7 at 7, 14-15, 18-19.; POR at 19-21, 28-30, 45-47.

(3) Shiraishi's layer 14 fails to satisfy the ordinary meaning of "covered by the lateral contact layer" because it is not a thin sheet spread across the sidewalls

In the POR, Patent Owner argued that this limitation is not met "even if the Board does not adopt Patent Owner's construction of "lateral contact layer." POR, 45. In particular, like the argument made with respect to Hirler (POR, 28-29, *Supra*, III.A.1.b.2), the POR noted that the ordinary meaning of "covered by the lateral contact layer" is consistent with a "thin sheet" being "spread over" the sidewalls. And the POR noted that Shiraishi's layer 14 does not satisfy this meaning because it is a layer of dopant that is implanted across the entire surface of the active region, from gate to gate. POR, 47. Notably, Petitioner's Reply contains no response to this argument. Reply, 18-21. Nor was this argument addressed by Petitioner or its expert in the Petition. Pet., 55-56 (citing Ex. 1003, ¶¶145-148). Accordingly, it is undisputed that Shiraishi fails to satisfy the ordinary meaning of "covered by the lateral contact layer."

(4) Shiraishi's layer 14 is not a "lateral contact layer" as properly construed because it does not have P* doping

The POR demonstrated that Shiraishi's layer 14 does not satisfy Patent Owner's construction of "lateral contact layer" because layer 14 is not disclosed as having P* doping (i.e. doping between P and P+). POR, 48-49. In its Reply, Petitioner makes the same argument it made in connection with Hirler—that it is

sufficient that Shiraishi's layer 14 has a doping concentration between that of the alleged base layer and the alleged base contact layer. Reply, 21. This argument fails for the same reasons discussed above in connection with Hirler. *Supra*, III.A.1.b.3. In particular, it fails to faithfully apply Patent Owner's construction, and is inconsistent with the specification of the '634 Patent which that construction is based on.

C. Ground 5: Kobayashi-Shiraishi Fails to Render Obvious the Challenged Claims

The POR demonstrated that the Petition contains no basis for concluding that Kobayashi would benefit from Shiraishi's punch-through stopper layer, i.e. a showing that Kobayashi suffered from punch-through. POR, 54-56. In its Reply, Petitioner asserts that "avalanche breakdown and punch-through, are interrelated." Reply, 23. But that does not show that Kobayashi suffers from punch-through, which is what Shiraishi's layer 14 is designed to "stop."

The POR also demonstrated that Kobayashi expressly teaches away from the proposed combination because Kobayashi is specifically focused on avoiding increased dopants near the channel region (due to the effect on threshold voltage), and Petitioner's proposed combination would do exactly that by adding Shiraishi's layer 14. POR, 56-57. In reply, Petitioner characterizes this as a "rehash" of the arguments in Ground 4. Reply, 23. Patent Owner believes its non-obviousness

arguments for Ground 4 also have merit as discussed in the POR. POR, 52-53. However, the combination that Petitioner presents in Ground 5 is distinctly different than Ground 4. In Ground 5, Kobayashi is the base reference and Shiraishi's layer 14 is being *added* to Kobayashi's MOSFET. Pet., 56. As Patent Owner showed, and Petitioner fails to dispute, this would render Kobayashi's MOSFET inoperable for its intended purpose (avoiding increased threshold voltage due to impurities in the channel region).

The POR also demonstrated that there is no factual basis for Petitioner's contention that a POSITA would be motivated to combine Shiraishi's layer 14 with Kobayashi so that it covered the *entire* sidewalls of Kobayashi's source contact trench. POR, 57-58. In Reply, Petitioner repeats its argument that Shiraishi does disclose that its layer 14 covers the entirety of Shiraishi's source contact trenches. Reply, 24. That argument fails as discussed above. *Supra*, III.B.1.b.1. But, in any event, Petitioner fails to provide any reason why a POSITA would be motivated to cover the entirety of *Kobayashi's* source contact trenches in the base layer with Shiraishi's layer 14.

IV. CONCLUSION

For the above reasons, the Board should hold that all challenged claims are patentable.

Date: December 16, 2024

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Certificate of Service 37 C.F.R. § 42.6(e)

The undersigned certifies that on December 16, 2024, I will cause true and correct copies of the foregoing Patent Owner's Surreply to Petitioner's Reply, and all associated exhibits or appendices referred to therein, to be served electronically upon the following attorneys who have consented to service via email. Paper 18.

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